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Wireless Magazine

JUNE

AND MODERN TELEVISION

Edited by PERCY W. HARRIS M.I.R.E.

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Wireless Magazine

AND MODERN TELEVISION

Technical Editor: G. P. KENDALL, B.Sc.

Vol. XXI : JUNE, 1935 : No. 125

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Edited by Percy W. Harris, M.I.R.E.

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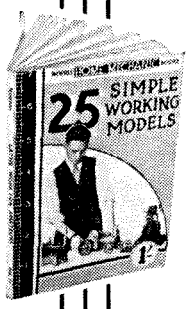

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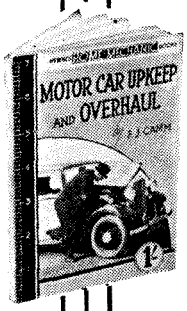

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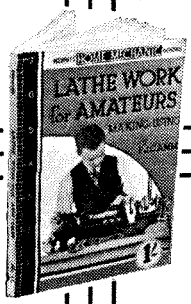
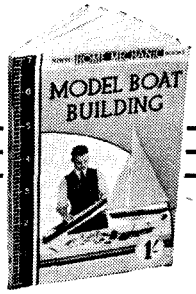




GEORGE NEWNES LIMITED, Southampton St., Strand, W.C.2

Wireless Magazine
and Modern Television

The Editor's Page

June, 1935

Our Semi-professional Three-valver

IN presenting to " W. M." readers the new semi-professional design of set, as exemplified in Mr. G. P. Kendall's three-valve receiver this month, we hope successfully to bridge the gap, which in the last few years has opened out and tended to widen, between home-constructed and professionally-built receivers. This new method of construction is the result of a careful study in fundamentals, without which study no real progress can be made. The mere re-arrangement of parts just to make the set " different," the attempt to make the introduction of one new component the excuse for a so-called " new " design, or the production of some little wanted result, do not form a part of the " Wireless Magazine " policy.

Study the design of the P.T.P. Three this month and you will find that the new arrangement of parts and the originality of the design have together led to such an extreme simplicity and efficiency of wiring that its advantages are obvious.

It is too often supposed that the nearer an amateur-built set can approach to a professional model in style, the better it will be—a fallacy which is based on a misunderstanding of professional design.

Rightly or wrongly the retail price of commercial wireless sets has been forced down to such a low level that the reduction of manufacturing cost and the paring off of fractions of a penny here and there, the ability to place the assembly of the set in the hands of relatively unskilled and therefore cheap labour and the adaptation of the design to some particular component or set of components which can be obtained at a low cost, are all of very great importance to the manufacturer.

Indeed, unless the most careful attention were paid to these points we should not obtain that remarkable value which characterizes this year's receivers.

If by re-arranging a design the total time of assembly and testing can be cut by half an hour it may mean all the difference between profit and loss for a commercial-set manufacturer. If, at the same time, efficiency is in no way sacrificed this re-designing has everything in its favour, but a change which facilitates production in factory conditions does not necessarily make work easier for the home constructor—often quite the reverse !

The home constructor aims to produce a good set at a reasonable price with the minimum of tools and in conditions which do not allow of a battery of stamps, eyeletting machines and an assembly line. It is very easy, when you are turning out hundreds of sets, to stamp out a complicated chassis in steel and suspend it in a cadmium plating bath for the requisite time to give it the desired finish, but this does not mean that a metallised wood baseboard with a few pieces cut to form bridges and brackets will not be equally efficient electrically.

It is, indeed, electrical efficiency combined with mechanical simplicity and strength that we aim to achieve in our designs rather than the slavish copying of methods not at all applicable to the home.

In the second article on our Jubilee Radiogram readers will find many details of the final adjustment and use of this receiver, which has already aroused widespread interest and enthusiasm. The 1935 Stenode—sharpest tuning of all superhet receivers—is shown this month in a specially designed cabinet which forms a worthy home for a remarkable receiver, while a soundly designed short-wave adaptor will be welcomed by those who are experimenting for the first time in this fascinating field of work.

It is of little use explaining " how " unless we give equal consideration to " why." In accordance with our policy of publishing sound and clearly written theoretical articles from the pens of recognised experts, we have collected together this month a more than usually valuable group of such contributions. " Fading and the Non-Fading Aerial," by Mr. J. H. Reyner, shows and explains what is being done to reduce the annoyance of fading on distant stations; " Keeping H.F. Where It Belongs " is a subject which grows with importance almost every month, and Mr. Marcus G. Scroggie—another of our regular contributors—shows in his usual lucid manner what to do and how to do it.

Next month we are beginning a new series of articles by Dr. N. W. Maclachlan, one of the greatest living authorities on loudspeakers. Dr. Maclachlan will deal in his first article with transients thereby seriously disturbing the views of those people who think that the ordinary form of published loudspeaker curve means a great deal !

Percy W. Harris.

Is the Portable Worth While?—see page 381

"I would never have believed it was possible to produce a DC/AC superhet for 11½ gns. with such good tone and performance *but* 'H.M.V.' *have certainly done it!*"

"SPEAKING as a man who knows something about radio, I must say that this new 'H.M.V.' set is really a splendid bit of work in every way. It's got A.V.C. and all that sort of thing of course—and as for the performance—well, it has certainly made me revise my ideas of what you can get for 11½ gns. in a DC/AC set . . . I know what to recommend when my non-technical friends ask me which set they should buy. You might remind me to write to "His Master's Voice" for a folder about this set. I'd like to keep it by me."

'HIS MASTER'S VOICE'

UNIVERSAL (DC/AC) SUPERHET FOUR MODEL 340

"HIS MASTER'S VOICE." THE GRAMOPHONE COMPANY LTD., 98-108 CLERKENWELL ROAD, LONDON, E.C.1.

By
L. W. HAYES,
of the
B.B.C.
Engineering
Staff

B.B.C. photo
The B.B.C.'s receiving station at Tatsfield, Surrey

"Five Hours Back"

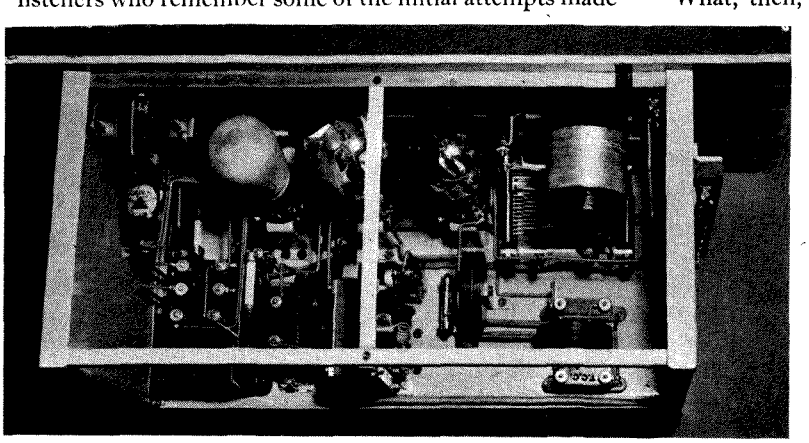
How the Saturday Afternoon Relays from America are carried out with such Remarkable Success is fully described in this Exclusive "W.M." Article

"FIVE hours back! Tea-time in London—lunch-time in New York." Listeners to the B.B.C. National programme will be familiar by now with this announcement, introducing the half-hour relay from the National Broadcasting Company of America, which has been given each Saturday afternoon at 4.45 p.m. for the past few months.

Generally speaking, these relays have been most successful and the progress made in recent years in relaying by short waves cannot fail to have struck those listeners who remember some of the initial attempts made ten or eleven years ago. Then, as now, an American short-wave broadcasting station was received in this country, and the output of the receiver was connected to the B.B.C. network of transmitters.

Indeed, one of the American short-wave broadcasting stations now available for the "Five Hours Back" programmes—W8XK at Pittsburg, Pennsylvania—is the modern counterpart of the pioneer short-wave broadcasting station of the world, KDKA at Pittsburg, from which the original attempts to relay were made.

What, then, is responsible for the great difference in the results? First, the modern short-wave broadcasting transmitters—and there is now a choice of several; to wit, W8XK Pittsburg, W2XAD Schenectady and W3XAL Bound Brook, New York—are more powerful than their predecessors; they are capable of a higher degree of modulation without distortion; they use more suitable wavelengths and they have better transmitting aerials.



A part of the short-wave relaying receiver at Tatsfield. This illustration shows the second detector and automatic-volume-control panel

Accurate Forecasts

Now—and this point is of great importance—our knowledge of the propagation conditions of short waves is far greater than it was ten years ago; we can now forecast with reasonable accuracy the particular waveband which is likely

They do big things in America! The new Western Electric 500-watt loudspeaker known as the "bull horn," which was used for the first time aboard a coast-guard cutter at the International Yacht Races

to be most suitable for transmission over a given path at a prescribed hour at a given season.

This does not yet mean that we can be certain of getting first-class reception at a fixed time, for propagation conditions change widely from day to day and from hour to hour; but of a certain number of wavelengths we can forecast those which are likely to be best received.

Better Receivers

Thirdly, present-day receivers and receiving aerials are very much in advance of those available ten years ago. The original short-wave relays from America were picked up on what would now be considered a primitive receiver, installed in the private house of one of the B.B.C. engineers, the output of the receiver being connected by telephone line to Savoy Hill and thence to 2LO, the London transmitter at Marconi House.

The B.B.C. now has a receiving station at Tatsfield, Surrey, equipped with modern short-wave receivers and special aerials. Readers may already know that Tatsfield has also comprehensive apparatus for checking the frequencies (or wavelengths) of stations, but that is outside the scope of this article.

In addition, there are other receivers which cover practically the whole waveband from 5-10,000 metres.

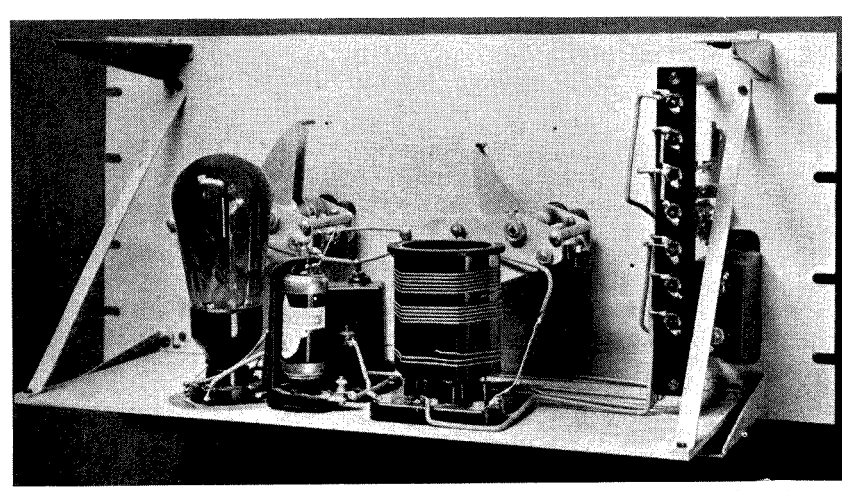
Tatsfield is at present equipped with two short-wave relaying receivers, built to the designs of the B.B.C. Research Department. Two further similar receivers are being installed to permit of " diversity " or " spaced-aerial " reception, which we will describe later. The receiver is of the superheterodyne type and covers the short waveband from 13 to 80 metres in four separate ranges—13-22 metres, 20-32 metres, 31-50 metres and 49-80 metres.

Change-over from one waveband to another is made by coil switching, the coils for the four ranges being mounted in a drum. The drum can be revolved by turning a knob on the front panel and each coil is brought into circuit by a set of fixed brushes which make contact with the coil connections brought out on the periphery of the drum. A cam and spring serve to locate the four positions of the drum at which contact is made with the four coils, and the number of the range connected is shown by the appropriate figure 1, 2, 3, or 4 visible through a window in the front panel.

Circuit of the B.B.C's Receiver

The circuit of the receiver is as follows : a signal frequency H.F. amplifying stage is coupled to an anode-bend triode valve first detector. A separate triode oscillator is used, and this is coupled to the first detector through a .0001-microfarad condenser in series with a 20,000-ohm resistance, these being connected between the high potential ends of the coils in the grid circuits of the local oscillator and frequency changer valves.

The local oscillator valve has a tuned anode circuit with grid reaction, magnetic coupling being used. The H.F. and detector stages form one unit and the oscillator stage a second unit.



Simplicity seems to be the keynote of the B.B.C.'s short-wave relay receiver. Our photo shows the local oscillator panel

There are three intermediate-frequency amplifying stages, the first forming a unit by itself while the second and third stages form another separate unit. Coupling between the stages, from the first detector to the first intermediate-frequency stage and between the third I.F. stage and the second detector is magnetic, while that between the first and second I.F. stages, and between the third I.F. stage and the second detector is variable and can be adjusted from the front panels.

There are in all six tuned circuits at intermediate frequency and the two pairs of these, of which the coupling is variable, form band-pass circuits. The tuning condensers

of these circuits are variable from the front panels and any desired intermediate frequency within a range which covers approximately the medium-wave broadcasting band can be selected.

When Several Sets Are Used

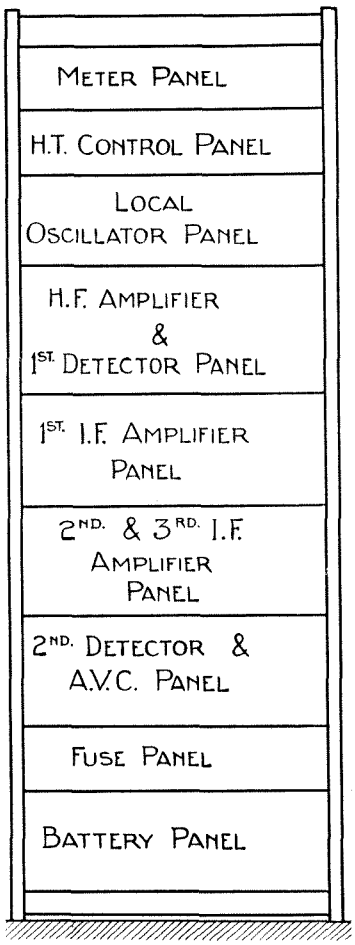
When several sets may be used to receive the same station simultaneously, it is important that different intermediate frequencies be used so as to avoid interference between the oscillators.

There are two second detectors; one, a diode, is used to give the low-frequency output, while the other, a triode, is an anode-bend detector for automatic gain control purposes. These two valves with their associated circuits are mounted in one unit, which also contains a low-frequency output valve.

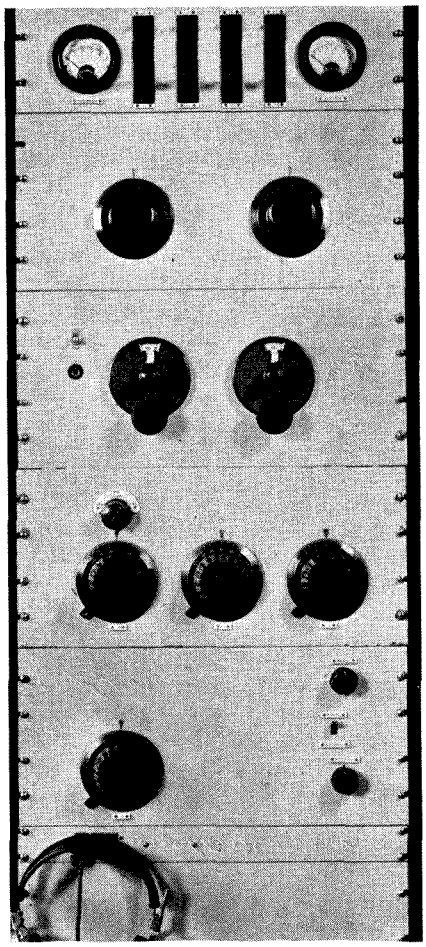
Means of Volume Control

Provision is made, by means of a two-position switch, for the use of either manual or automatic gain control. The control bias in either position of this switch is fed to the grids of the H.F. and the first and second I.F. valves, all of which are variable-mu tetrodes. The third I.F. valve grid has fixed bias and this valve is an ordinary screened-grid tetrode without variable-mu characteristics.

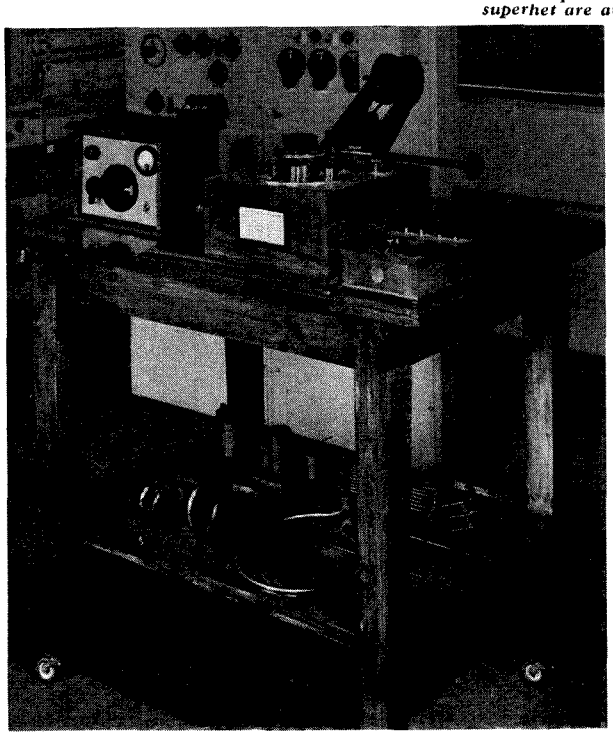
By means of the automatic gain control a signal variation at the aerial terminal of the receiver of 65 decibels is reduced to a variation at the second detector of 4 decibels. The receiver is battery operated, accumulators giving 8 amperes at 6 volts for the low tension, 40 milliamperes at 200 volts for the high tension, while a dry battery gives 5 milliamperes at 100 volts for the automatic gain control valve. Panels are provided for fuses, meter switching, H.T. potential divider circuits and to house the 100-volt battery.



This drawing shows how the various parts of the short-wave superhet are arranged in the rack



The receiver used at Tatsfield is built up on the rack principle as shown here. It is 6 ft. 6 in. high



Special care is taken at the B.B.C.'s Tatsfield receiving station to check up the wavelengths of all short-wave broadcasters. Here is the wavemeter—calibrated from 10 to 100 metres—which is used for the purpose

The complete receiver is rack-mounted, the rack layout being shown in an accompanying drawing. The rack is 19 in. wide and 6 ft. 6 in. high. Suitable tappings are provided on the aerial coupling coils for low-or high-impedance aerials or feeder lines.

What the B.B.C.'s Set Will Do

It may be of interest to give a brief note on the performance of this receiver. When the equipment is adjusted to give full gain it is capable of fully loading the output valve with an input of considerably less than one microvolt, but the lowest value of useful signal input is in practice limited by the noise generated internally in the receiver itself. Care has therefore been taken to keep this internal noise as low as possible.

The adjacent channel selectivity is substantially constant at all wavelengths for a given setting of the band-pass couplings since it depends principally on the I.F. amplifier characteristics. The image signal or second-channel selectivity is such that the image signal is attenuated 60 decibels below the signal at 50 metres and 30 decibels below at 16 metres.

There is a number of short-wave receiving aerials at Tatsfield, some of which are suitable for omni-directional reception, while others favour signals coming from New York. Both horizontal and vertical aerials are used. A very simple type of aerial, which has proved satisfactory, is the inverted "V" of Bruce. This type of aerial is suitable for covering a band of wavelengths from approximately $.7\lambda$ up to 3λ where λ is the optimum wavelength for which it is designed.

The Horizontal Diamond Aerial

A development of this type of aerial, the " horizontal diamond " or " rhombic " aerial—also due to Bruce—will also cover a band of waves, and two aerials of this type are now being erected at Tatsfield in order to improve the performance still further.

In short-wave reception the aim must always be towards getting the highest possible signal to noise ratio, whether in the aerial or in the receiver to which it is connected. In a commercial point-to-point telephone service the strength of signal can be considerably increased by the use of highly directional transmitting aerials, but this is, of course, not possible for a short-wave broadcasting station; it becomes essential to do all that is possible to cut down noise at the receiving station. Furthermore, a greater signal-to-noise ratio is necessary for a good broadcast relay than for a commercial telephone conversation.

Fading Experiments

Several years ago a series of experiments was undertaken by the B.B.C. and the Marconi Company in this country in collaboration with the N.B.C. and the Radio Corporation of America in the United States to investigate a means of reducing fading in the reception of short-wave signals. It had been observed that fading did not take place simultaneously on two or more receivers tuned to the same station if the receivers and—which is more important—their aerials were erected at some distance from each other.

Diversity Reception

Accordingly, two aerials were set up some distance apart and their outputs were led by feeder lines to a central point where the receivers were installed and the low-frequency outputs of the two receivers were combined. Subsequently, a third aerial and receiver were added and it was found that the combined output showed considerably less fading than any one of the individual receivers.

For " diversity reception " suitable arrangements have to be made for combining the outputs—reversing keys provide a convenient method of ensuring that the low-frequency output from each receiver is connected the right way round, and some inter-locking is essential between the automatic gain control circuits of the individual receivers so that the receiver which is momentarily producing the strongest signal " takes charge " and thus reduces the gain of the other receivers so that they may not contribute noise to the common output. An aerial spacing of about 1,000 ft. is found suitable in practice.

More Receivers and Aerials for Tatsfield

While it is unlikely that " diversity " working will improve short-wave reception when conditions are very good, it is found in practice that the percentage of time during which a certain standard of reception can be reached is considerably increased by this method. It is for this reason that more short-wave receivers and aerials are being provided at Tatsfield.

Some of the " Five Hours Back " programmes have already attained a high technical standard. It is to be hoped that this standard will be achieved more often in the future, both in this series and in any subsequent series which may be arranged.

Name This Receiver!

A Free Set for the Best Name

A new three-valve A.C./D.C. receiver to be marketed by Universal High Voltage Radio, Ltd., which readers are invited to name. It has its own electric lamp and an eight-day clock

The directors of Universal High Voltage Radio, Ltd., will present a receiver as shown above to the reader who, in the opinion of the Editor of "Wireless Magazine," suggests the most appropriate name. The following rules, however, must be observed:—

1—Only one name may be submitted by one reader.

2—Each attempt must be accompanied by the coupon to be found on page 400 of this issue.

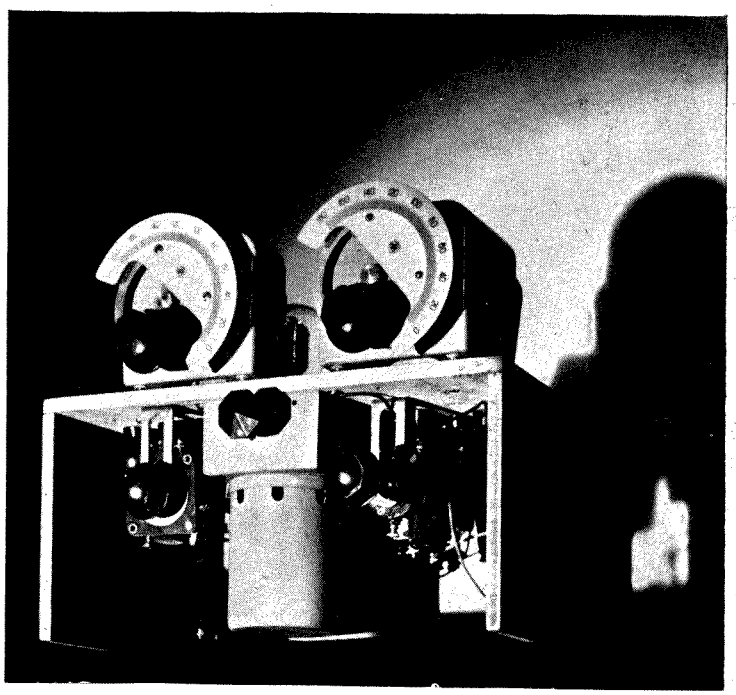
3—No employee of George Newnes, Ltd., or Universal High Voltage Radio, Ltd., is eligible to enter this competition.

4—No correspondence will be entered into regarding this competition: the Editor's decision is final and legally binding.

5—Entries should be addressed to Set Competition, "Wireless Magazine," 8-11 Southampton Street, Strand, London, W.C.2, and must reach this office not later than first post on Monday, June 17, 1935.

The Result of this Competition Will be Published in the August Issue of "Wireless Magazine"

Here we present first details of an outstanding battery receiver built on a new and improved system. It employs a highly efficient combination of H.F. and L.F. pentodes, gives exceptional selectivity and sensitivity, and sets a new standard of efficiency of layout combined with great ease of construction



The P.T.P. Three

(Pentode—Triode—Pentode)

Designed by G. P. KENDALL, B.Sc.

FOR some twelve years it has been my business to study the trend of the home-construction movement, and I think that I can now spot its tendencies and interpret its symptoms as quickly as the next person.

Ahead of Its Time

It is my considered opinion that the design of the home-built receiver is at present suffering from a period of rapid circuit and component development without corresponding progress in methods of construction. I foresaw this condition some two years ago and made an attempt to introduce a system to render sets both more efficient and easier to build, but it was ahead of its time and although the more experienced constructors realised its importance, to the majority it was "just another Press stunt."

I have worked on the problem ever since and now that a measure of reform is definitely overdue it seems time to try again. Conditions today are quite evidently more propitious; in the case of the readers of "W.M." I know that I am presenting my ideas to a body of people with sufficient technical knowledge to appreciate the fundamental principles involved, and everyone has now had a chance to realise that there is something lacking in a set design which may offer meritorious circuit arrangements but does not provide the vital feature of ensuring easy and accurate duplication of the original performance by the reader.

I'm afraid that last remark sounds rather superior; let me hasten to explain just what I mean. The modern high-efficiency design of circuit gives results dependent to a very large degree upon the exact layout and method of wiring. Consequently, unless something very definite is done to fix these matters by the method of construction, any subsequent copies may or may not give the same good results as the original instrument.

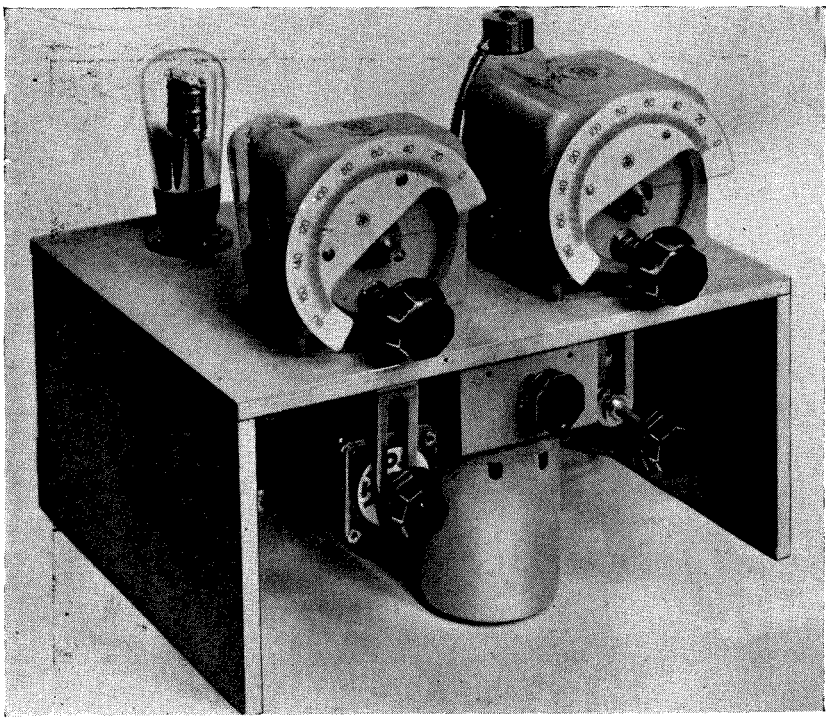
What is Needed

What we want is some system of construction to guarantee that the ordinary small departures made by the builder will have no marked effect upon the behaviour of the circuit. The system should further render it easy to construct the receiver and give an appearance at least equal to that of a good professionally-made instrument.

Current Methods Fail

Let us examine the conventional methods and see how far they satisfy these requirements. The simple panel-and-baseboard system is now little used except for the more elementary types of circuits; a modified form can be made to serve quite well, as in the case of the Editor's 1935 Radiogram, if the power circuits are built into a separate unit,

A NEW BATTERY THREE BUILT IN A NEW WAY



Here is the completed receiver ready for fitting to its cabinet. Of the three knobs on the lower level, that on the left controls reaction, the centre one is the combined wave-change and on-off switch, and on the right is the volume control

but for the majority of circuits it has many drawbacks.

The all-metal chassis is often used and by proper design can be made to yield the desired rigid fixation of layout and wiring. In this way it is quite possible for a skilful designer to arrange matters in such a fashion that the conscientious constructor can be pretty sure of making an exact duplicate of the original receiver.

Metal Chassis Problems

In the case of such highly specialised circuits as the Stenode this is probably the safest way to carry out the design; in receivers of this type an exact copy of the smallest details may often be essential and then the ready-drilled metal chassis and the specified kit of parts must be employed.

For general use this system must be admitted to have many objections. It leaves the builder no chance of using up stock parts and this in itself is a severe limitation : most of us have a number of good-quality components which we should like to use for a new set.

The slightest mistake in drilling by the makers of the chassis may involve the constructor in great mechanical difficulties, and it is not always easy to obtain every one of the specified components. A final drawback is that the method is apt to be expensive.

A wooden structure on chassis lines is probably a more practical solution of the problem, but this in its customary form usually leaves something to be desired; although there is no need for accurate drilling, since the parts can be attached with wood screws, the screening effect of the metal chassis is absent and the appearance tends to be untidy.

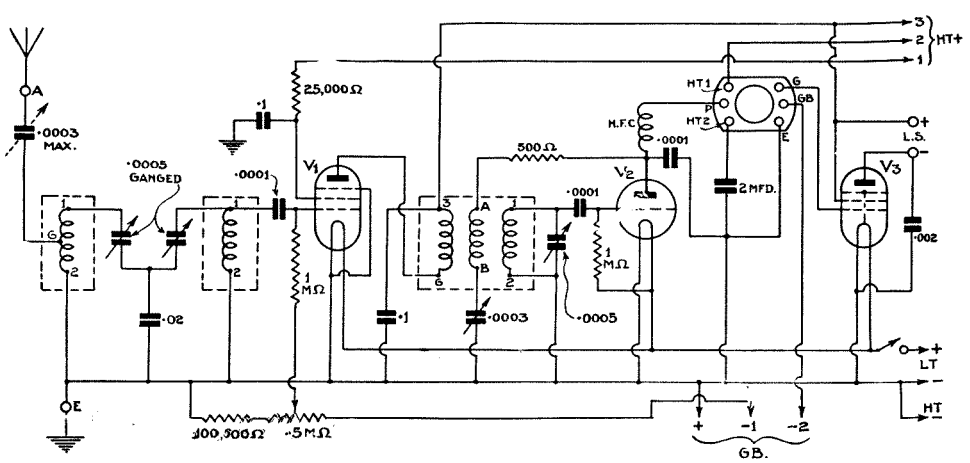
Professional Appearance

The expedient which I have adopted for the P.T.P. Three seems to me to be free from these objections and yet combines the best features of the metal chassis and the wooden structure. All the parts can be mounted just as easily as in the wooden baseboard system, the desirable screening effect of a metal surface is available, and the appearance is quite professional.

The essence of the idea lies in the use of a wooden framework which has been sprayed with a layer of metal. This skin is an excellent conductor and gives full screening effects and can even be used for the completion of earth-return circuits, yet it is so thin that components can be mounted with the aid of wood screws in just the usual fashion : it is merely necessary to prick a small starting hole and then the screw can be driven home into the soft wood beneath.

Copying is Automatic

By the careful use of both sides of the main metallised surface I have found it possible to work out a plan which fixes the layout of the parts and the run of the wiring so rigidly that accurate copying of the design is an almost automatic process.



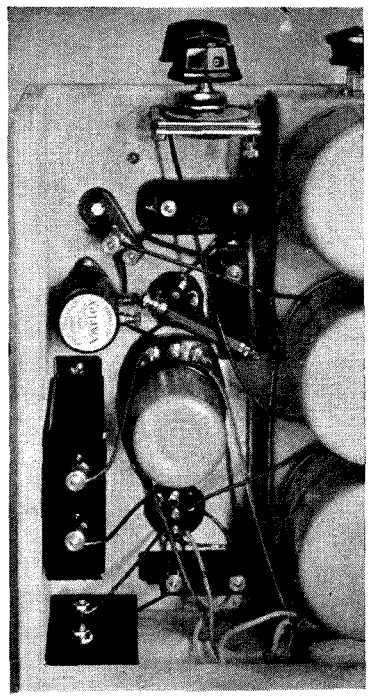
The circuit provides band-pass input arrangements to the high-frequency valve, with transformer coupling to the detector. Very excellent selectivity and sensitivity result from this arrangement when high-efficiency iron-core coils are used

At the same time by keeping the wiring itself almost entirely on *one* side of the surface in question I have managed to make it extremely simple. Actually it can be traced out entirely from a single diagram, without any of that tiresome business of following a given wire until it dives into a hole and then reappears on another diagram !

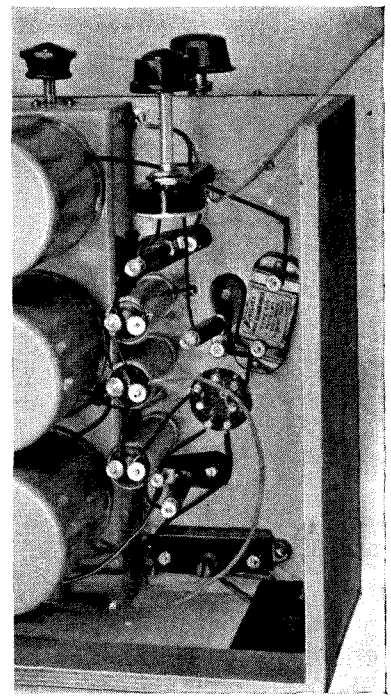
Safety Factor

These perhaps are "negative virtues"; they are merely features which prevent one from going wrong or unwittingly making a harmful departure in some important wiring or layout detail. Now let us look at the very weighty positive virtue of the scheme.

This really follows from the fact that the design is so arranged that all ordinary small departures from the precise layout are harmless; it is the result of the way the various sections of the set have divided up by screening masses of various kinds.



Underside view showing detector and output circuits. Note that the grid leak is suspended in the wiring



The H.F. input side. The metal coil chassis helps to screen this off from the output side

Effective Separation

In order to achieve this desirable condition the design has been laid out to take advantage not merely of the screening effect of the metallised wood surfaces, but also of the large metallic mass of the coil screens and coil switch chassis. In this way the input circuits of the high-frequency amplifying stage are so shut off from the output side of the stage that considerable liberties can be taken without ill-effect.

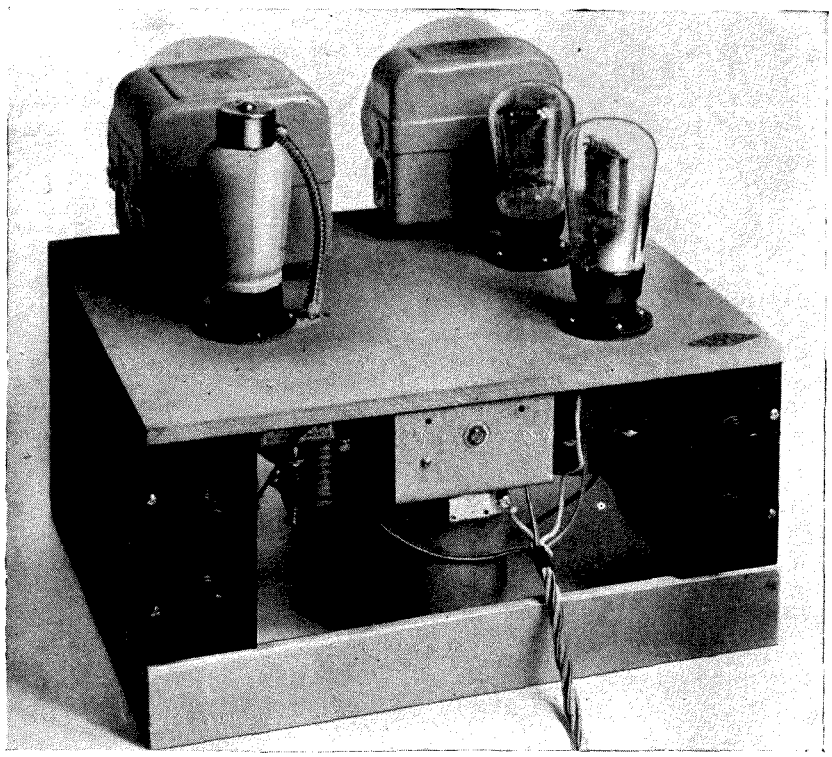
There is, for example, the matter of length of leads in the wiring. It is generally argued that the crucial wires must be kept short at all costs, and one sometimes sees very peculiar things done in order to bring about this condition. What some folk tend to forget is that the *object* of keeping these leads short is to prevent them from producing undesirable interaction effects with wires in other circuits.

If such actions can be prevented by other means there is no point whatever in taking a lot of trouble to keep the wires ultra-short; not merely is it unnecessary, but it has, in certain cases, no effect at all upon the working of the circuit.

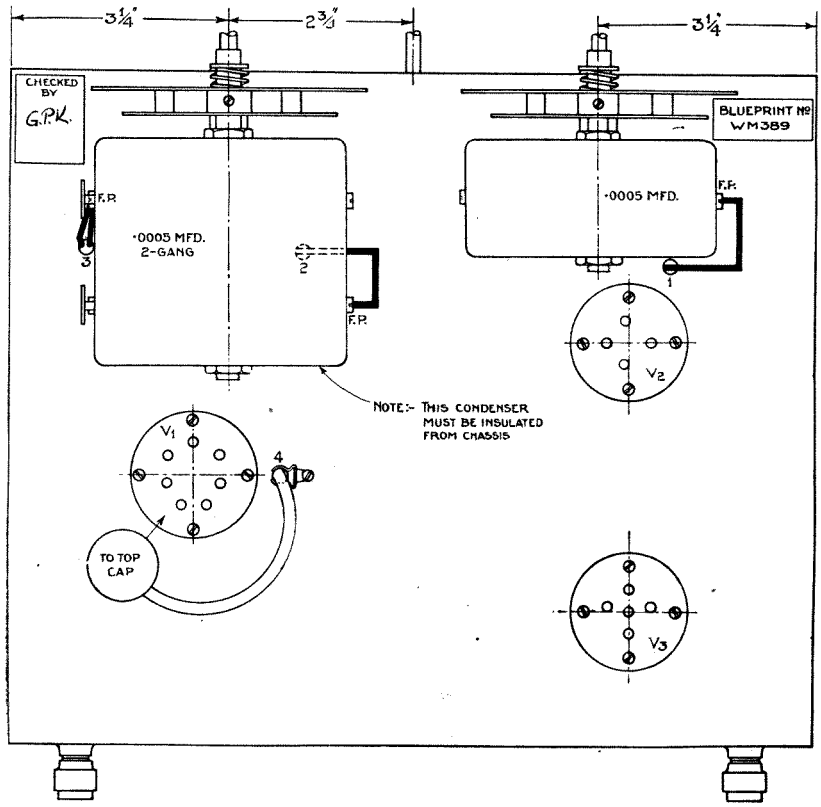
Proportion Wanted

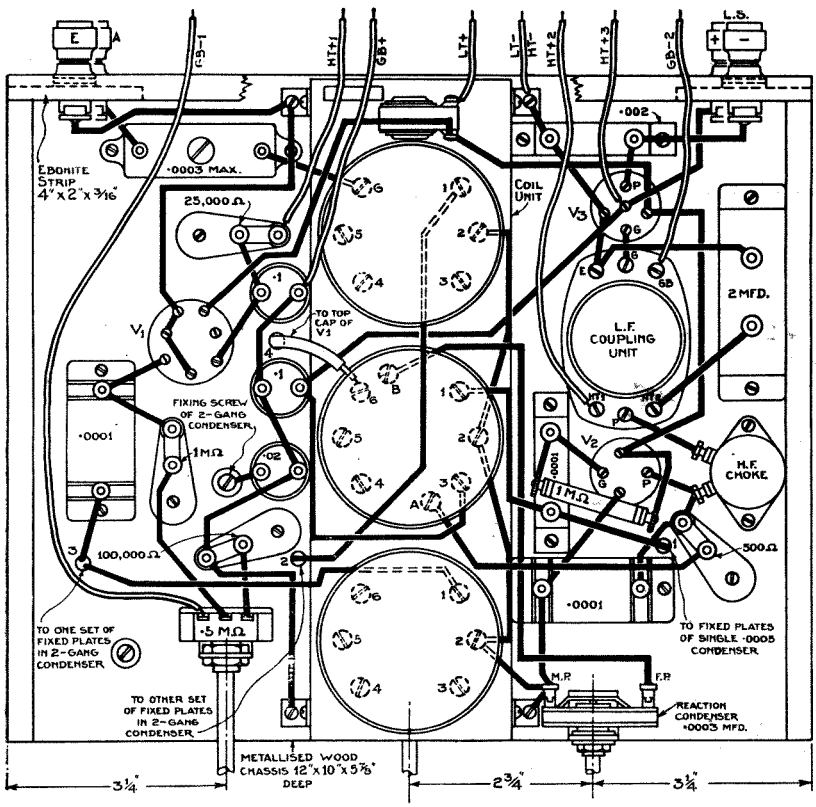
This should not be taken as a free licence to abandon all the rules of good wiring, but I do want to urge that we should cultivate a sense of proportion in the matter. So long as due precautions are taken to eliminate objectionable interactions there is no need whatever to go to a lot of pains to maintain ultra-shortness in wires from which there is already a large capacity shunted to earth, as in the case of leads from a circuit across which there is a tuning condenser.

The result of the special method used in the P.T.P. Three is to produce what I have no hesitation in recommending as an extremely fine receiver. Sensitivity and selectivity are quite definitely above the level which



The new system of construction gives a particularly neat and pleasing appearance when the set is finished





SCALE REPRODUCTION OF THE BLUEPRINT

A full-size blueprint of this wiring diagram is available, price 1s., or, if application is made before June 29, it can be obtained at the special price of 6d., post paid, providing the coupon to be found on the last page is used. Ask for No. W.M.389

would be obtained from the same circuit and components in a more conventional assembly.

Quality is good, the set handles well, and it seems to be about as good a battery three-valver as can be designed at the present time. Especially pleasing is the fact that the background is particularly clean and quiet.

In the course of the first evening's trial of the receiver it produced really good signals from thirty-seven medium-wave stations without the need for any real finesse in the use of the reaction control. With care and patience the set is capable of bringing in more but I do not regard formidable lists of stations prepared in this way as a fair guide to a set's powers; for the benefit of those who like these things I will see what can be done about such a list for our next issue, but it is not my idea of the proper way to assess performance !

Band-pass Coupling

The circuit is of the band-pass input type, with "bottom-end" capacity coupling. Here I would explain that I have experimented considerably with the value of the coupling capacity and find that it is practical to suggest that selectivity may be adjusted to suit special requirements at this point.

For general work with really good selectivity a capacity of .02 microfarad is advised, but in situations where conditions are not good and there is no local station problem it is quite permissible to use .01 microfarad and so obtain tighter coupling with consequent slight gain in volume.

Alternative Selectivity

The aerial is taken to the first coil unit through a series condenser (adjustable) of .0003 microfarad maximum capacity and here again individual modification is possible. The intention is that the condenser shall be regarded as the standard arrangement, and it can be kept at maximum for all normal work; lower settings are needed only in positions of exceptional difficulty.

Where the utmost selectivity is not of paramount importance or when the aerial is on the small side the condenser can be cut out of circuit by the simple expedient of joining its two terminals together with a piece of wire.

The high-frequency amplifying valve is of the variable-gain pentode type and volume control is provided

in the usual manner with the aid of a potentiometer circuit which applies a varying negative bias to the grid. The coupling from this valve takes the form of a high-frequency transformer; this method has electrical advantages and in addition enables one to dispense with the usual H.F. choke and coupling condenser.

Detector Stage

The detector is a triode (I am not very fond of the pentode here when the best of quality is desired, although I am willing to admit that it has its merits, and even to use it on occasion). The reaction circuit has been arranged with considerable care to ensure that really effective amplification can be obtained when required; when one has but a single H.F. stage, even a hard-working one like this, it is no use being snobbish about the use of reaction !

Low-frequency coupling is provided by a self-contained parallel-feed transformer unit of a compact type. I have taken advantage of the opportunity provided by this unit to incorporate a little de-coupling for the detector stage. This is done by the 2-microfarad condenser and a resistance contained in the unit. There is not much space here, by the way, so if you wish to use some other form of coupling make sure there is room.

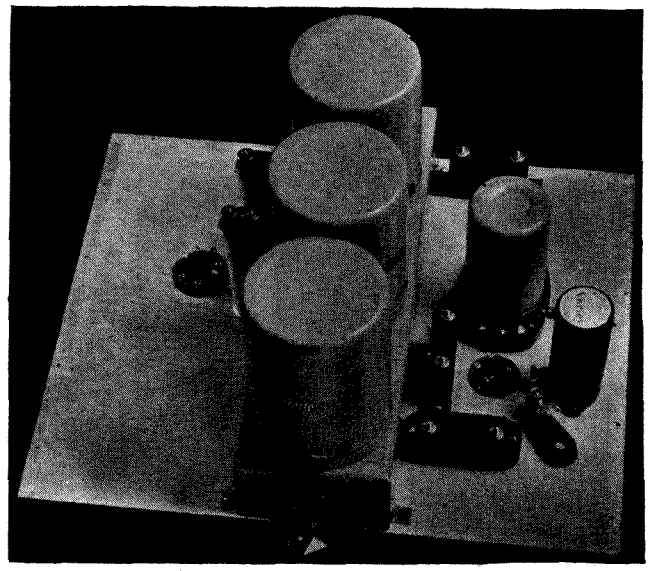
Valves for the P.T.P. Three

The output valve is a pentode and I have introduced a trifle of mild tone-correction in the form of a .002-microfarad condenser from anode to earth.

My choice of valves for the set was based to a large extent on the need for high-tension economy in a battery outfit. Those suggested will give a good all-round performance, but if larger power-handling capacity is desired it can be obtained by substituting a pentode of the Pen220A type in the output position and possibly a valve such as the L2 as detector.

Now I must just give some brief practical notes so that the readers can get the set assembled and into operation. Next month I shall have more space and will deal in detail with the working of the set.

In building the receiver the first step is to detach the sides and back of the chassis frame, leaving just the flat top. On this you can assemble all the parts with the greatest of ease, just as you would on a baseboard.



All the preliminary assembly work and most of the wiring can be done easily if the sides and back of the chassis are removed

Fix the two tuning condensers in place *before* you attach the coil unit, and remember to scrape away the metallising round the feet and fixing screws of the double-gang condenser; it must be insulated in this way from the earth circuit, and connected by a wire from one of the fixing screws to a terminal of the .02 condenser.

Only when the assembly and wiring is otherwise complete should you attach the sides and back of the chassis frame and connect up the terminals.

Hints on Wiring up

In the wiring, by the way, be careful to keep the lead to No. 1 on the rear coil unit over on the same side of the coil chassis as the " V1 " valve : do not let it stray over on the detector side. Remember also to earth the screening covering of the special top connector of the H.F. valve by means of the clip provided.

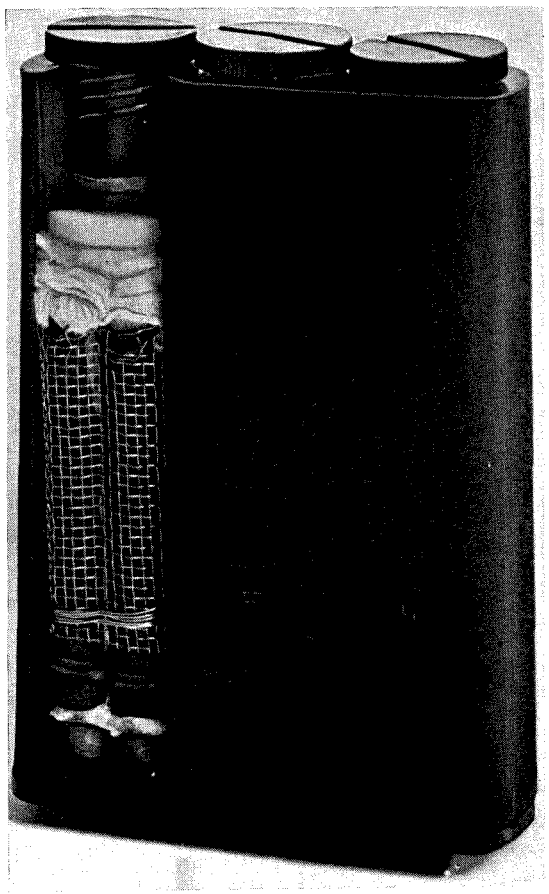
Operating notes : apply 120 volts to H.T.+3, about 90 to H.T.+2, and from 70 to 100 to H.T.+1 (adjust for maximum volume). Give G.B.—1 about 7½ volts and 4½ to G.B.—2 (For Pen220). Trim the twin-gang condenser and the set is ready for its trials.

COMPONENTS NEEDED FOR THE P.T.P. (Pentode-Triode-Pentode) THREE

	£	s.	d.
CHASSIS			
1—Peto-Scott to specification, wood, sprayed Metaplex with terminal strips. ...		6	6
CHOKE, HIGH-FREQUENCY			
1—Varley multi-cellular junior ...		3	6
COILS			
1—Goltone 3-coil switch chassis, coil types G.I.C.3, G.I.C.4, and G.I.C.6. (G.I.C.4 coil in centre, G.I.C.6 nearest to switch knob)	1	5	0
CONDENSERS, FIXED			
1—Dubilier .0001-microfarad, type 620		1	3
2—Dubilier .0001-microfarad, type 610		2	6
1—Dubilier .002-microfarad, type 620		2	0
1—Dubilier .01 or .02-microfarad, type BS9200 (see text)... ...		1	9
2—Dubilier .1-microfarad, type BS9200		3	6
1—Dubilier 2-microfarad, type BS		2	8
CONDENSERS, VARIABLE			
1—J.B. Nugang single-stage .0005-microfarad condenser (type A, with disc drive)		10	6
1—J.B. Nugang two-stage .0005-microfarad condenser (type A, with disc drive)		17	6
1—Graham-Farish Litlos .0003-microfarad reaction		2	0
1—Graham-Farish Formo .0003-microfarad compression ...		1	6
HOLDERS, VALVE			
1—Clix Air-sprung 7-pin		1	1
1—Clix Air-sprung 5-pin		1	0
1—Clix Air-sprung 4-pin			11
HOLDERS, RESISTANCE			
4—Graham-Farish Ohmite, vertical type		2	0
TRANSFORMER UNIT			
1—Benjamin Transfeeda		11	6
RESISTANCES, FIXED			
1—Graham-Farish Ohmite 500-ohm		1	6
1—Graham-Farish Ohmite 25,000-ohm		1	6
2—Graham-Farish Ohmite 1-meg-ohm		3	0
RESISTANCE, VARIABLE			
1—.5-megohm Centralab volume control, long-spindle type ...		3	9
SUNDRIES			
1—Bulgin 5-way battery cable ...		1	6
4—Belling-Lee terminals, type R...		2	0
2—Peto-Scott mounting brackets, short length, for reaction condenser and volume control ...		0	8
1—Belling-Lee screened low-loss valve-top connector		1	6
1—Set Bulgin matching knobs (if desired)			
Battery plugs, wire, sleeving, flex, etc.			
ACCESSORIES			
VALVES			
1—Mazda VP215		13	6
1—Mazda HL2		5	6
1—Mazda PEN220		13	6
BATTERIES			
1—Full O'Power 120-volt high-tension		17	6
1—Full O'Power 9-volt grid-bias		1	3
1—Exide 2-volt accumulator, type DMG-C		12	0
LOUDSPEAKER			
1—Amplion Dragon (in chassis form)	1	9	6

The Gordon

First Details of a



Showing the 3-cell Gordon magnesium battery which will shortly be available for use with deaf-aid appliances. One compartment has been cut away to show the interior construction

IT is a great many years since any real novelty was introduced into the design of primary batteries. All of those in common use—the Bichromate, the Fuller, the Daniell, the Bunsen and the Leclanché—are variations on one single theme : the " burning " of zinc by means of chemical action, the electrolyte being either dilute sulphuric acid or sal-ammoniac.

It is therefore refreshing to come across a battery which is entirely new in every way. Except that it uses a carbon positive, like the Bichromate and the Leclanché cells, the Gordon is completely different in its make-up from any other—and even the carbon is used in an entirely novel way, as we shall see presently.

Water Electrolyte

The Gordon cell uses water—just plain water from the tap—as its electrolyte ; its negative element is magnesium and its behaviour is quite unlike that of any other primary cell. Let me say at once that it is not yet on the market ; it is therefore of no use to write to me to ask where it can be obtained. I can give the answer here and now : it can't.

It is however being developed by one of the most important electrical engineering firms in the country ; it has passed far beyond the laboratory stage and it will no doubt be in production before very long.

The accompanying photograph illustrates a 3-cell Gordon battery which will eventually be available for use with deaf-aid appliances.

The papier-mâché case is divided in to three compartments, each of which houses four sets of elements connected in parallel and thus forming a single cell. One of the compartments in the battery illustrated has been cut away so that its interior can be seen.

How It is Constructed

Actually each compartment consists of four carbon tubes, each containing a magnesium rod, the whole four being bonded together with a wrapping of copper gauze to ensure the best possible contact. The reason why the cells are made up of four sets of elements is just that which prompts us to use cabled wire made up of several strands for certain purposes.

The surface area of four rods and four tubes is very much greater than that of a single rod and tube of the same total diameter : each component of the quadruple cell is about the size of a cigarette.

Fig. 1 shows, for simplicity's sake, the construction of a simple Gordon cell consisting of but one rod and tube. Between the magnesium and the carbon there is a " wick " of wood-wool brought out from the bottom of the tube to form a pad, which rests on a block of potassium bromide and is kept moist by means of the tap water.

At this point the reader may say, " Aha, I thought there was a catch somewhere ; it isn't the water but the potassium bromide which does the trick ! "

I'm sorry, but it really isn't ! The cell will work without the potassium bromide, but the presence of the latter serves a useful purpose in keeping down the internal resistance.

I said just now that the carbon was used in a way quite different from that found in other cells.

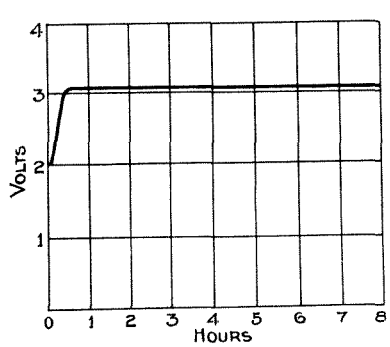


Fig. 2.—Showing the voltage curve, taken over eight hours, of the discharge of a Gordon magnesium battery with a load of 100 milliamperes. Note that the voltage delivered rises immediately the cell is brought into use

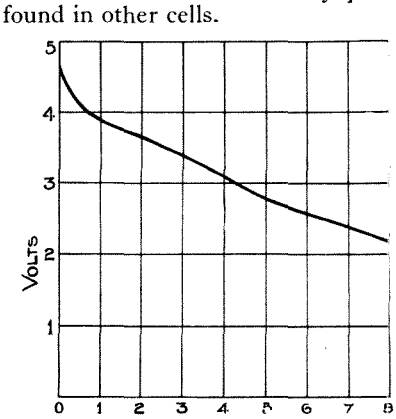


Fig. 4.—Discharge of a 3-cell Leclanché battery of same weight as Gordon under same load. Compare this with Fig. 2

Magnesium Battery

Described by R. W. HALLOWS, M.A.

Complete Revolution in Battery Design

If you will look once more at Fig. 1 and compare it in your mind's eye with the Leclanché cell I think you will spot the difference. In the latter there is a central carbon rod and in the dry form of the cell a cylindrical zinc. You will notice that in the Gordon cell the carbon forms the cylinder, the rod being inside it.

And it is not only the construction of the cell that is so unorthodox ; when in action its behaviour is in several ways just the opposite of others. Most other cells for instance settle *down* to their working voltage ; when you connect them to some piece of apparatus the voltage falls at first rather rapidly and then flattens out. Unlike them (and some human beings too!) the Gordon cell settles *up*.

"Warming Up" a Gordon Battery

Look at Fig. 2 which shows a record of an eight-hours run under a load of 100 milliamperes of a Gordon deaf-aid battery of the type illustrated. You will observe that during the first half hour the voltage *rises* steadily from something under 2.5 to 3.1. Once it has reached the latter figure it remains perfectly steady.

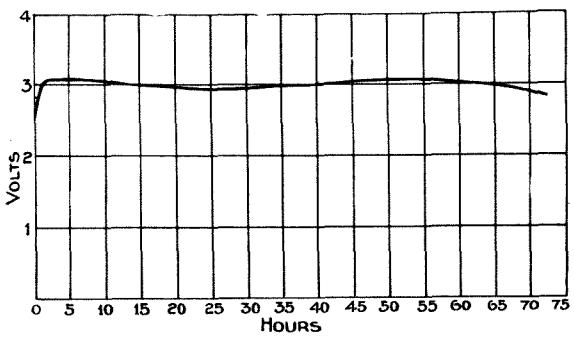


Fig. 3.—The continuous discharge of a Gordon 3-cell battery under a load of 100 milliamperes would produce a curve as shown above

This curious rise in voltage is apparently due to the effects of " warming up." When the battery is switched on its cells are cold, but as it delivers current there is a distinct rise in temperature.

This probably assists the potassium bromide to get to work in cutting down the internal resistance with the result that the voltage rises.

You can bring the battery up to full voltage in a few moments by placing it temporarily under a much heavier load. If, for instance, a flash lamp bulb is connected to it the filament is for some moments barely red hot. Then you see it growing rapidly brighter and brighter until it is glowing at its full brilliance.

Another very striking peculiarity of the Gordon battery is that its service life is actually rather better under a continuous load than if it is used intermittently. When, for example, it is delivering 100 milliamperes a battery of the deaf-aid type will operate for some 72 hours before the voltage falls to 2.8 ; but if the same load is applied for 8 hours a day—the battery being rested for the other 16 hours—the total service will be a little less.

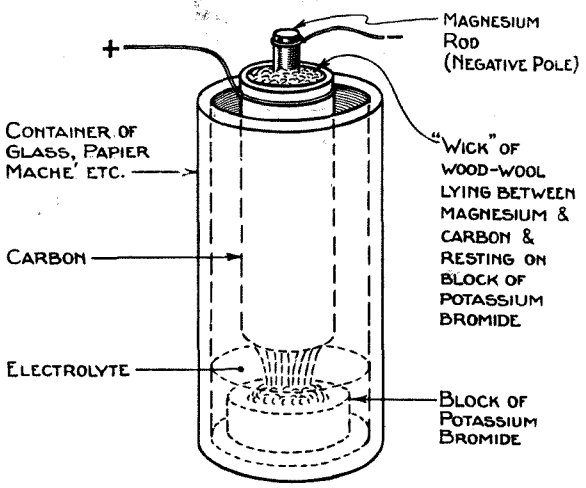


Fig. 1.—The arrangement of the Gordon cell can be clearly seen from this drawing

Fig. 3 shows the record of one of these batteries under a continuous run of 72 hours whilst delivering 100 milliamperes of current.

The trouble with all zinc-consuming batteries is that they suffer from what is known as polarisation. This means that unless counteracting measures are taken any kind of zinc cell becomes rapidly choked when called upon to deliver current, the result being that the current falls quickly away towards zero.

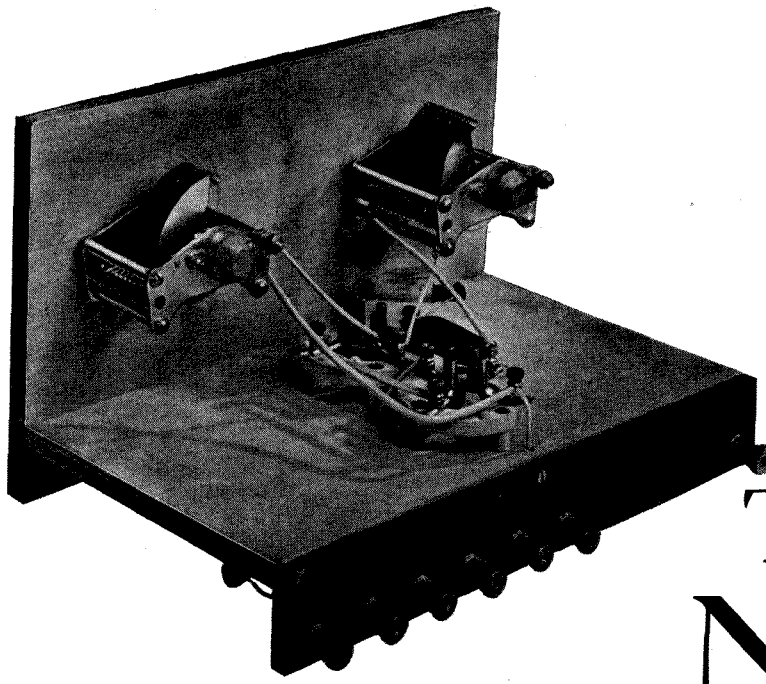
Leclanché—the Popular Primary Cell

By far the most widely used primary cell today is the Leclanché in its dry form. Here the depolariser occupies much more space than the electrolyte.

Even so its action is very far from perfect unless the load is minute. A battery composed of Leclanché cells starts to lose voltage, as Fig. 4 shows, the moment that it is called upon to do work. Your high tension battery, to take an example, may read 100 volts before you switch on at 6 p.m., 90 volts an hour later and 85 at bedtime.

In other words it is slowly polarising all the time that it is in use. Rest it overnight and it will pick up a considerable proportion of the lost volts ; but as soon as you work it again there is a still greater fall than there was on the previous occasion. What this means is that the quality of your reception cannot be so good at the end of any evening as it was at the beginning and that it is just a little worse at a given hour on any evening than it was at the same hour on the previous one.

Except in the laboratory, the Gordon cell, which does not polarise, has not yet been made up into a high-tension battery, but this will undoubtedly be a future development and when it comes we shall be assured of a supply of perfectly steady current for the plates of the valves in a battery set.



Here we present details of a simple but highly efficient unit which enables excellent short-wave reception to be obtained when used in conjunction with any ordinary receiver. A special feature of this unit is that it can be used alone as a single-valve short-wave receiver

The "W.M." New Style Short-wave Adaptor

The simplicity of layout which you see here is a striking proof of the great care bestowed upon the design by the author

Designed by G. HOWARD BARRY

THERE has always been a certain charm about a short-wave adaptor, which has appealed chiefly to the class of listener that prefers to treat short waves as an "extra." The construction of a complete short-wave receiver, together with its battery supplies or mains unit, hardly seems worth while when one's chief interest in radio remains centred on the reception of broadcast entertainment.

Double-purpose Unit

In the ordinary broadcast receiver one has (presumably) a good low-frequency amplifier and a useful source of H.T. and L.T. supply, and an easy means of receiving the short waves is undoubtedly to construct a simple adaptor which can be used in conjunction with the main receiver.

Such an adaptor can be one of two kinds: it can be a more or less elaborate affair for converting the broadcast receiver into a short-wave superheterodyne, using the H.F. stages and feeding from the adaptor into the aerial circuit of the set. On the other hand, it can be of the very simplest type, consisting only of a short-wave reacting detector, which is simply coupled to the low-frequency side of the broadcast set.

The simple adaptor described here is made with the object of reducing complications to the very minimum. It *could* be made more cheaply, but I never believed in spoiling the ship and I have used really good components throughout. It is a novelty in one respect since it is constructed essentially as a complete single-valve short-wave receiver. It may be used, with headphones, as such.

Most adaptors are simply equipped with a plug which ties them to the broadcast receiver, but this is a complete receiver in itself with the plug available to those who want to use it!

There is no need for me to discourse on its simplicity—the photographs and diagrams will do that. I should like to emphasise the point that this desirable quality has *not* been obtained at the expense of efficiency and that no essential has been left out, either to cheapen or to simplify the adaptor.

First let us analyse the circuit diagram. The conventional series-fed reaction circuit is used with a triode of the "HL" class as detector. Tuning is effected by a .00015-microfarad short-wave condenser, which may be supplemented with a small band-spreading condenser if the reader so desires. Reaction is controlled by a .0001-microfarad variable between the low-potential end of the reaction coil and the earth line.

Reaction Precaution

Instead of the usual high-frequency choke a 10,000-ohm resistance is inserted in the anode circuit, since it is possible (or even probable) that the adaptor will be fed into a transformer-coupled stage. I always prefer to follow up a short-wave detector with resistance coupling, but the slight troubles attendant upon transformer coupling are often cured by this use of a resistance in place of a choke.

The aerial is coupled to the high-potential end of the grid coil through a very small fixed condenser made by twisting two wires together. These may be seen in the diagram of the underside of the set, and their total length is between 4 and 5 in. Ordinary tinned copper wire encased in Systoflex is used for this as for all the wiring.

Two Distinct Advantages

This scheme has two distinct advantages. Most important, it enables the adaptor to be calibrated. This is distinctly desirable, but is not possible when one uses a variable or pre-set condenser in series with the aerial.

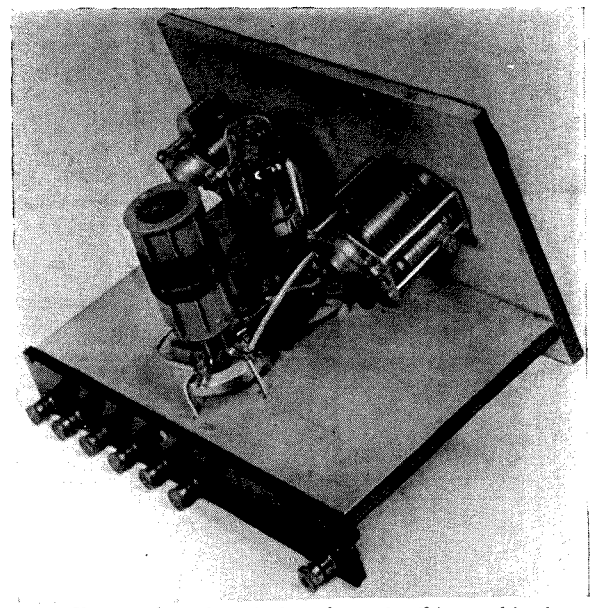
Secondly, human nature being what it is, nearly everyone provided with variable aerial coupling will use too much of it, obtaining stronger signals at the expense of selectivity. This wouldn't matter if it stopped there, but such people generally turn and rend the designer for putting out a flatly-tuning receiver.

Coupling

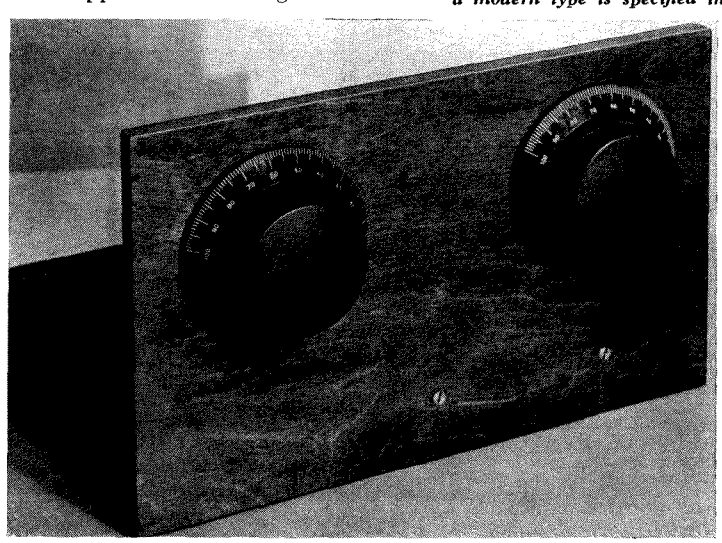
The coupling provided is, admittedly, very small. It is, however, perfectly satisfactory for use with an outside aerial. If readers wish to use the set with a small indoor aerial they will be well advised to increase the degree of coupling by lengthening the lead from the coil to the aerial terminal, and giving it 9 to 10 in. of twisted wire. To achieve this it may be made to take a roundabout path round the baseboard before going to the aerial terminal!

Please note, whatever you do, that there is no actual metallic connection between the coil and the aerial. The lead from one is twisted round the lead from the other, and both leads have a free end.

So much for the theoretical circuit. Now let us consider the constructional aspect in detail. Forgive me if I tell you how good the layout is! The grid condenser forms the lead from the grid terminal of the valve holder to the appropriate terminal on the coil holder. The lead from the anode to the reaction coil is almost as short.



Showing the unit with the valve and coil inserted in the correct holders. Note that our contributor used some brass terminals which he happened to have on hand; a modern type is specified in the list of components



Here you see that there are only two controls; on the left, tuning, and on the right the reaction control

Short heads

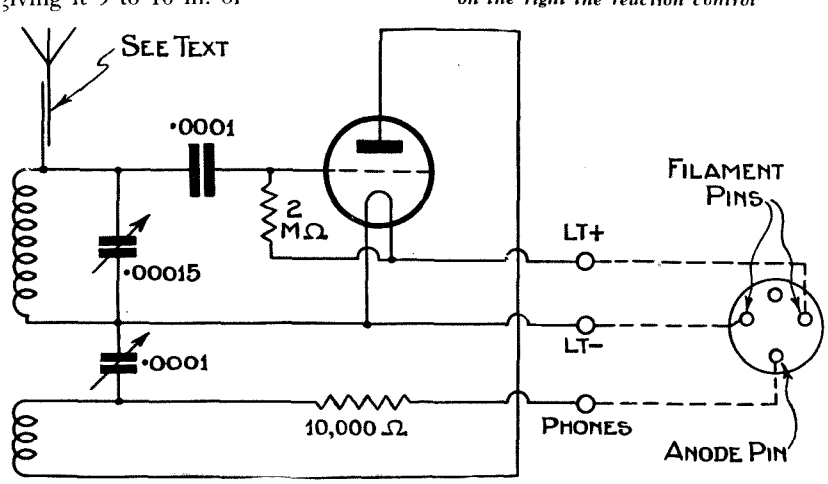
The all-important leads from the tuning condenser to the coil which it tunes are both reasonably short and are certainly direct; the same applies to the wiring of the reaction condenser.

The panel and baseboard are both 10 in. by 6 in., the baseboard being mounted 1 in. up from the bottom of the panel so as to accommodate what little wiring is taken underneath.

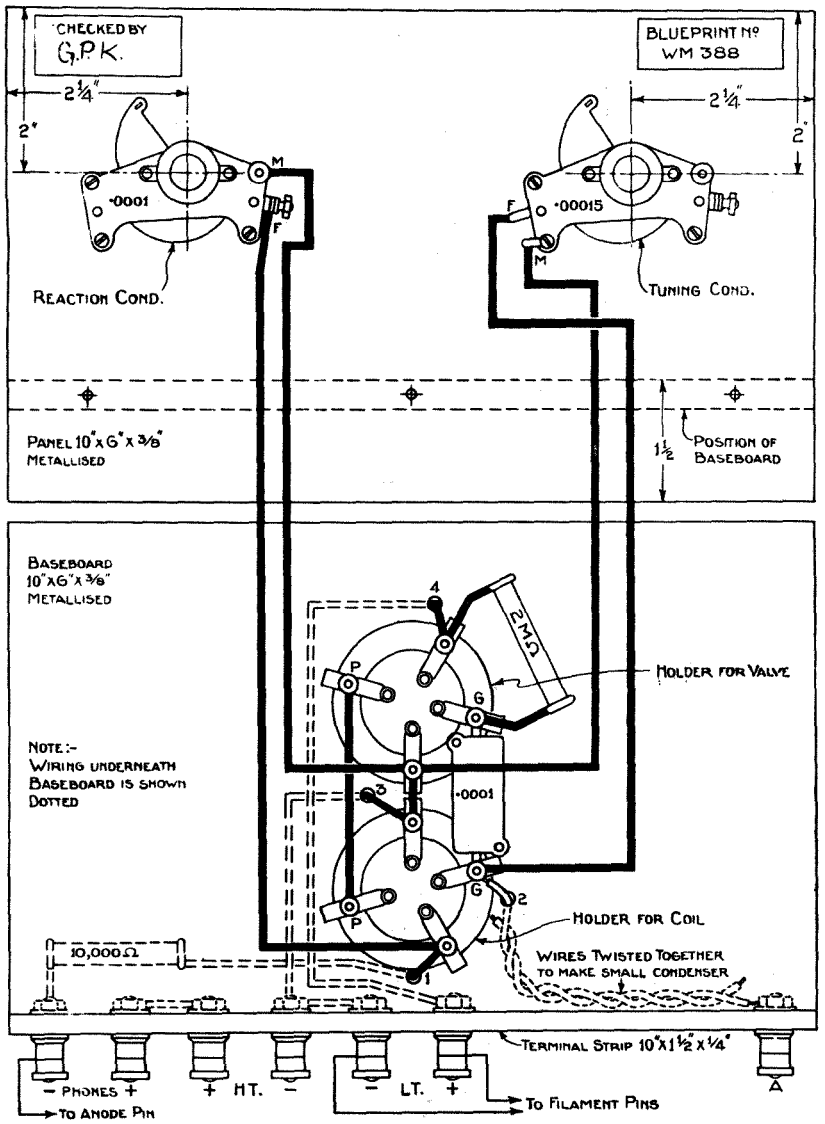
Direct Wiring

Although Metaplex has been used it has not been relied upon to form any part of the circuit and direct wires connect the moving plates of both condensers with the negative low-tension terminal on the valve holder.

The values of .0001-microfarad for the grid condenser and 2 megohms for the grid-leak do not show any originality, but we are out for results rather than innovations, and they are definitely the most satisfactory



The circuit diagram has been drawn in such a manner that the connections to the connector plug can readily be followed



A full-size blueprint of the "W.M." New Style Short-wave Adaptor can be obtained for half price, that is 6d., post paid, if the coupon to be found on the last page is used before June 29. Address your application to the "Wireless Magazine" Blueprint Department, George Newnes, Ltd., 8-11 Southampton Street, Strand, London, W.C.2, and ask for No. WM388

values for the average 2-volt battery valve.

We will assume now that the adaptor is completed and awaiting its first test. It will be best to treat it as a single-valve receiver and for this purpose all seven terminals at the back are used. A 60-volt battery should be connected across the high-tension terminals and, naturally, 2 volts of L.T., aerial, and headphones in the appropriate places. An earth can be connected if desired to L.T. negative.

Not Worth Trying!

Don't try the effect of interchanging the coil and the valve just because the holders are similar. I haven't worked out exactly what *would* happen, but I can assure you that no advantage would result from it! The valve holder is the one nearer to the front panel.

A valve such as the Tungsram LD210 should be inserted and I suggest that the first test be made with the "R" (red spot) coil in place. This covers a range of roughly 41-95 metres if the aerial coupling capacity is small. If you are using more than the suggested length of twisted wire for this coupling, the minimum wavelength reached by this coil will probably be about 45 metres.

In any case the 49-metre broadcast band will come in near the bottom of the tuning range and you should have no difficulty in identifying several stations. Don't expect strong signals from the single valve but, at the same time, don't be disappointed if the set seems "dead."

There should be an almost complete absence of background noise and yet signals will be stronger than you would imagine from the quiet effect of the set. As I have said before the ratio of signal to background that one can obtain with a good single valve receiver is just about as favourable as anything that can be produced.

The "Y" (yellow spot) coil covers a range of about 22-47 metres; in other words, it goes downwards from where you leave off with the "R" coil. The 25-metre broadcast band will be found low down in the tuning range, with the 31-metre band near the middle of the condenser scale.

Completing the Range

The 40-metre amateur band will be found near the top of the scale and the 36-metre ship-to-shore telephony a little lower.

The "LB" (light blue spot) coil will take you down from 25 to about 13 metres and includes the 20-metre amateur band and the 19, 16 and 14-metre broadcast bands. The 19-metre band is one of the most interesting and should be found at about 50 or 60 on the 100-division scale.

The fourth coil is a type "W" (white spot) and brings in the 80-metre amateur band at the bottom and the 160-metre band at the top. Further coils may be obtained for covering the broadcast bands if necessary.

Adaptor Connections

So much for the use of this unit as a receiver. Only a very small change is necessary if it is desired to turn it into an adaptor. A four-pin adaptor for a valve holder is necessary. The grid pin is left blank; the anode pin is connected to the negative "Phones" terminal, and the filament pins to the L.T. terminals: all this can be done with flex leads or some sort of multi-way cable.

Apart from the aerial, which must be transferred from the receiver, no other connections must be made to the unit; that is to say, the positive "Phones," positive H.T. and negative H.T. terminals must be left free, and the earth must be left connected to the main receiver.

Assuming that you have a battery-operated broadcast receiver with 2-volt valves, all that you have to do

is to remove the detector and insert the adaptor-plug in its place. The short-wave detector will then derive its filament supply from the detector-valve holder in the broadcast set and the anode circuit will couple straight through (whether transformer or resistance coupling is used) to the low-frequency side of the broadcast receiver.

A.C. Version Later

It may not even be necessary to use a new valve in the adaptor as the one that does duty as detector in the broadcast set will probably be perfectly suitable!

All this may seem a little hard on those who use A.C.-operated broadcast receivers, but I hope to be able to describe an adaptor particularly designed for them at a later date. After all, the average all-A.C. broadcast receiver is sure to have a good H.F. side, and it is a better plan to use a superhet-adaptor with such a set, particularly when one considers that its L.F. side may consist only of a single pentode.

This simple little unit, as it stands, should be an excellent means of introducing yourself to the joys of short-wave reception and is intended as a starting-off point. Superhet adaptors are rather more complicated in construction and operation; they will be dealt with later on.

In conclusion, I may mention that the following stations have been heard, using the unit as a single-valve receiver with headphones: Sydney (VK2ME), Rio de Janeiro, Schenectady, Pittsburgh, Boston, Miami, Nairobi, and all the Europeans. The above were logged in two days and it is fairly safe to say that any station transmitting on the short waves might be heard if an extended-period log were kept.

For the benefit of those who may wish to use B.T.S. coils in this unit it is pointed out that the connections differ from those shown on the wiring diagram. Actually the "P" point on the holder for these coils is the one to carry the grid condenser, "G" goes to earth and the reaction winding is across the "F" points. A special diagram showing these connections in detail will be given next month.

COMPONENTS REQUIRED FOR THE "W.M." NEW STYLE SHORT-WAVE ADAPTOR—

	s.	d.
BASEBOARD		
1—Peto-Scott baseboard (10 in. by 6 in.) and wooden panel (10 in. by 6 in.)—Metaplex sprayed on top of baseboard and inside of panel	1	3
CABLE		
1—Bulgin four-way cable ... ... (*Only 3 points used*)	1	3
CABLE PLUG		
1—Bulgin 4-pin cable plug, No. P9	1	9
COILS		
1—set Eddystone short-wave coils, 4-pin type	16	6
CONDENSERS, FIXED		
1—Dubilier .0001-microfarad, type 670	1	0
CONDENSERS, VARIABLE		
1—Polar .0001-microfarad slow-motion	8	3
1—Polar .00015-microfarad slow-motion	8	6
RESISTANCES, FIXED		
1—Erie 10,000-ohm 1-watt	1	0
1—Erie 2-megohm grid leak ...	1	0
TERMINALS		
7—Belling-Lee terminals, type R ...	3	6
TERMINAL STRIP		
1—Peto Scott terminal strip, 10 in. by 1½ in.	1	0
VALVE		
1—Tungsram LD210	3	9
VALVE HOLDERS		
2—Eddystone 4-pin (Frequentite model)	2	10

The July issue of "Wireless Magazine" will be on sale June 21. Order your copy now!

Interference Suppressors and Safety Requirements

Unsatisfactory Design of Suppressors Revealed by R.C.M.F. Letter

WE have received from the Component Manufacturers' Federation a letter which reveals a definitely unsatisfactory state of affairs in the design of suppressor devices for fitting to various kinds of domestic electrical appliances such as vacuum cleaners.

The Federation's letter points out that it is becoming the custom to fit these devices with condensers and other components of a test-voltage rating far below that required by insurance companies, the Board of Trade and other authorities.

Serious Consequences

The letter continues: "While the cheaper condensers are quite permissible inside a radio set where one failure in a thousand is not serious and merely means that the set stops working . . . one failure in a million in interference suppressors might be very serious since it would frequently result in the frame of an unearthed appliance becoming alive."

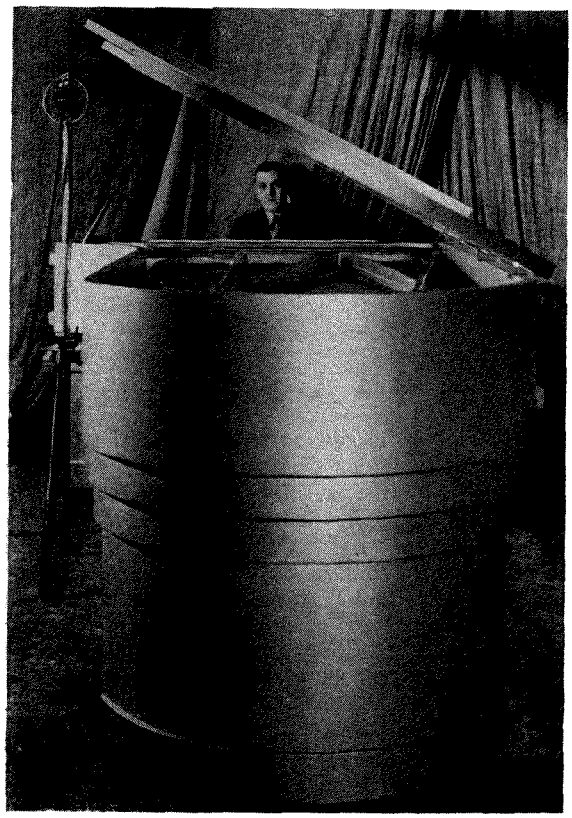
Standardised ratings, safety precautions and tests for interference suppressors have been laid down by the Federation in conjunction with the I.E.E., R.M.A., B.B.C., G.P.O., various electrical power supply authorities, and the British Electrical and Allied Industries Research Association.

Provisional requirements are that all condensers and other devices must withstand a test to earth of 2,250 volts D.C. Further, all suppressors must be protected by separate fusible cut-outs against the breakdown or overload of any component, except when the suppressor is built into and forms an integral part of the appliance, or when the suppressor is so designed that it can only be used in sub-circuits already protected by sub-circuit fuses of sufficiently low rating.

This, of course, means that any device which might conceivably be connected to the point of entry of the mains into the house must have separate fuses.

Additional Recommendation

An important additional recommendation is that all condensers contained in suppressors must be capable of ready disconnection by the removal of a plug or the withdrawal of fuses in order that customary insulation tests may be made on the equipment; false readings result in the presence of condensers when the test is made with certain types of apparatus commonly employed for the purpose. It is considered that electricity-supply authorities are likely to impose this arrangement as a definite requirement.



No, this is not a new wireless transmitter! It is Billy Mayerl, looking very small at one end of the world's biggest grand piano. The instrument took a year to build, cost over £600 and requires twelve men to move it!

What the B.B.C. is Doing

A Fair Deal for the West Country!

By T. F. HENN

ONLY last month I drew attention to the poor service area of the West Regional transmitters, and said "it is high time that steps were taken to do something." A friend 'phoned me up a few days after my last notes had gone to press and told me that during a tour round the Plymouth district he had seen a van suspiciously like that used by the B.B.C. for ferreting out broadcasting station sites.

I rather dismissed the idea until I paid a visit to Broadcasting House recently when I mentioned it to one of the officials. Whether my friend was right or not I cannot say, but the hush-hush van has been—or still is—down Plymouth way on the search. And I was told at the B.B.C. that the van is looking for a site upon which to build *a 50-kilowatt Regional station to serve the West Country.*

This is, indeed, cheerful news. The B.B.C. is giving the West a fair deal at last!

Only those who live in Devon and Cornwall or have toured in that part ot the country with car radio know the appalling reception conditions down there. The present West Regional and National have very limited service areas, and even Droitwich's many kilowatts have done practically nothing to ease the situation.

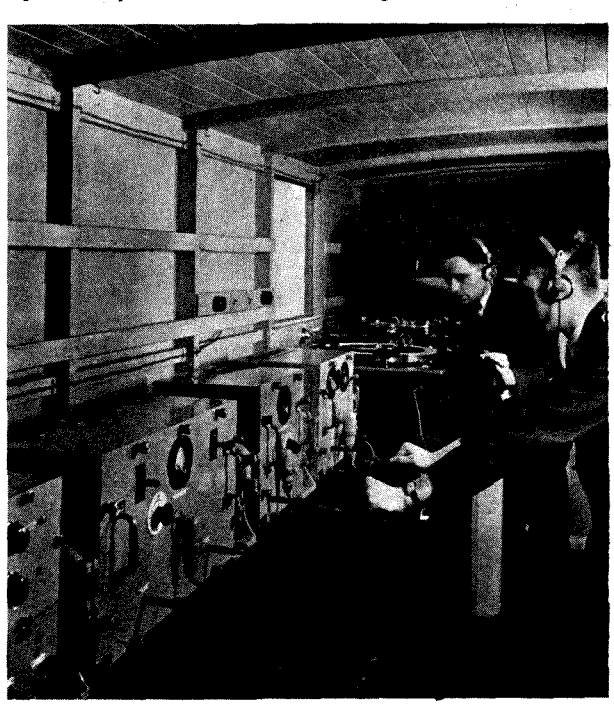
The B.B.C. is very clever; it is going to kill many birds with one stone. The introduction of "South-West England Regional" will see a complete remodelling of the Regional Scheme in the West Country. Plymouth's present relay is to be moved to somewhere near Bristol, where it will still continue to relay the National programme.

West National will "stay put," while West Regional will become Welsh Regional. The Welsh people have always had a grievance against the B.B.C.; they want programmes for Welshmen announced in the Welsh language. When the change takes place they will get all the Welsh they want, for Welsh Regional is to be devoted entirely to their interests.

The actual transmitter will not be moved, the B.B.C. having decided that a better service area in South Wales could not be obtained by moving the station to the north side of the Bristol Channel. North Wales is to be served by a new low-power station to be erected at Bangor.

Although plans for the new West Country Regional scheme are going ahead very quickly, it will be some two or three years yet before the new Plymouth station is open. One can take it that a new Regional station takes approximately a year to build.

The new Northern Ireland Regional at Lisburn will open this year; North Scottish Regional is to start next



Much of the atmosphere in recent programmes can be attributed to the mobile recording van. Our B.B.C. photo shows one of the two recorders. The amplifiers are on the left and the actual cutting machine is at the far end

year; then North-east England and the new Plymouth stations will follow in due course.

Will those readers who have already sent reports of reception conditions in Devon, Cornwall, and elsewhere, please accept our thanks; these reports will prove useful.

We have to thank, to some extent, the success of the experiment in synchronising London, North and West Nationals for the extra stations which are to be built. There is only a limited number of exclusive wavelengths available for Britain, and naturally many of the new stations will have to be synchronised with existing transmitters.

In my last notes I denied that the power of the three synchronised little Nationals—London, North and West—had been reduced to 20 kilowatts. The information came from a reliable source, and you can imagine my own surprise when I saw the official announcement of the power reductions in B.B.C. publications.

I tackled my informant, saying that he had rather let me in the cart. Here is his explanation; make what you can of it. "The power of the three little Nationals has never been 50 kilowatts and today it is *not* 20 kilowatts; the present power is definitely *less* than 40 kilowatts, but is *more* than 30 kilowatts."

I have made several calls on people in districts south-east of London, and I am of the opinion that something more than 5 kilowatts and less than 10 kilowatts would be a fair statement of the case! In fact, *Droitwich is becoming the National programme provider.* One is surely justified in asking what the game is. One has only to go a few miles south of London to find Radio Normandie on 269.5 metres a much stronger signal than London National.

That curious thought of mine; how will the B.B.C. relay a commentary of the Naval Review at Spithead in July? You remember that I suggested a battleship as the ideal commentator's box.

That, I learn, is the official selection.

The relay will be on the Boat Race lines. The small short-wave transmitter from the launch, *Magician*, will be installed on the battleship, and there will be a receiving station on shore to pick up the relay from *Magician's* transmitter and put it on to a telephone line to London, from where it will be distributed to all B.B.C. transmitters.

Usually there is a distinct falling off in feature programmes about June, but this year strenuous efforts are being made to sustain interest in broadcasting throughout the summer.

Of special interest is the production of *Bitter Sweet*, the famous musical play by Noel Coward which had a long run at His Majesty's Theatre, Haymarket, and later was filmed. The show will be broadcast twice; on May 31 and June 1. Although especially arranged for broadcasting, the show has been cut to last two hours instead of the usual one allocated to entertainments of this nature.

The Dancing Daughters have gone. I dared to enquire how many listeners had written to the Variety Director demanding their re-engagement. The B.B.C. has had a few letters expressing sorrow and a few more containing congratulations! Think what you will, but atmosphere has been lost.

A big event for June 18 and 19 is the annual relay of the Friends of Canterbury's Music Festival held in the cloisters of Canterbury Cathedral. As usual the B.B.C. Symphony Orchestra will provide the music.

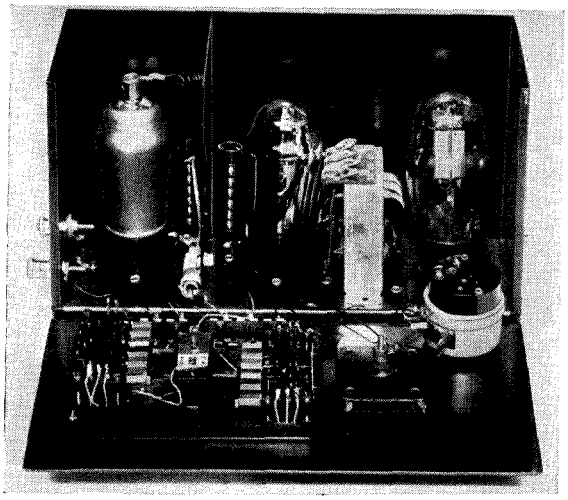
The Margate Municipal Orchestra is to join the already long list of seaside bands heard regularly over the air. Its first broadcast will be on June 2 in the National programme at 9.5 p.m.

Organ recitals from St. Paul's Cathedral are rare. Dr. Stanley Marchant is giving a forty-minute recital in Regional programmes on June 4 from 8.20 to 9.0 p.m. This fine organ was rebuilt some two or three years ago and is one of the finest instruments in the country.

Robert Tredennick, popular with Midland Regional listeners for his gramophone recitals, is seen here with the Paramount Astoria Orchestra under Anton—regular broadcasters—with Esme, the singer, in the Columbia recording studios. They were making a record, "Musical Moments," which was issued last month

New Idea in

First Details of a Novel Inven-



The new tuning unit applied to a three-valve receiver of conventional design. The tuning unit itself is attached to the fold-down front panel, being mounted on a metal screen. In use this panel is held vertically, the other side carrying the calibrated tuning dial

A NOVEL and ingenious new tuning unit has recently been invented by Mr. S. G. Brown, F.R.S., whose name is so intimately connected with the early progress of wireless in this country, and will be remembered in connection with the Brown telephones and the Brown loudspeakers. Mr. S. G. Brown himself recently demonstrated and explained his invention to a representative of " Wireless Magazine."

First of all the tuner is extraordinarily compact, consisting of what appears, at first glance, to be nothing more than a calibrated tuning dial mounted on a small plate at the back of which are placed a few bars ! Closer examination shows that the tuning dial operates gearing which moves two sets of six square bars of high-frequency iron in and out of two corresponding sets of six coils. Each coil is wound on a small quarter-inch square section former measuring only 1 in. long—about the size of the small resistors used in modern mains sets.

Inductance Tuning

There is none of the usual variable condensers and in fact the only condenser used is a small compression type needed as a trimmer. The tuning unit as a whole is mounted on a small panel about the size of a " flat-fifty " box of cigarettes and the same box of cigarettes serves as a fair guide to its total thickness.

The tuning dial is calibrated over about three-quarters of its circumference in red and black for long and medium waves respectively. There is of course, a change-over switch for the two wavebands and a micrometer adjustment fitted to the tuning knob provides for fine tuning, while a reaction control is also fitted.

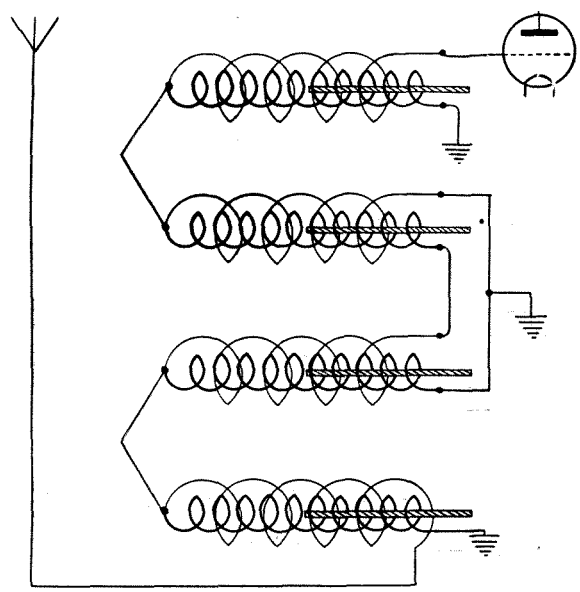
The appearance of a three-valve set fitted with this tuner is seen in our illustration, the tuning unit being on the back of the fold-down lid. The rest of the set is of conventional design and calls for no special comment.

Mr. S. G. Brown claims that the tuner works on an entirely new principle and offers the opinion that much of the theory has yet to be explained, but it would appear to us from a careful analysis of the tuner and its circuits, that conventional theory will at least indicate how it *could* work even if our explanation is subsequently disproved. Let us therefore examine the circuit in detail.

How Tuning is Effected

Tuning is effected by sliding iron cores in and out of fixed inductances. Each inductance is double wound, the winding running along as a single layer from one end of the former to the other and returning over itself, thus forming a conventional two-layer coil. There are six of these coils in the first grid circuit and six in the second, each set of the six corresponding iron cores being mounted on one bar and operated simultaneously by the tuning knob.

Closer examination shows that in each grid circuit all four of the coils are used for the medium band and two for the long. The coils are exceedingly small and wound with very fine wire. The tuning range of each is more than adequate for the particular band.



Our analysis of the circuit of the tuner. Tuning is effected by moving the iron cores in and out. One end of each coil is earthed as you can see

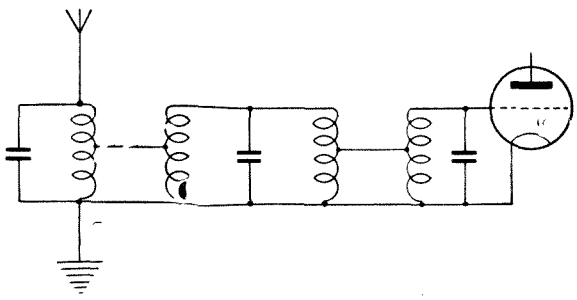
The method of joining up is interesting and is indicated diagrammatically in our drawing. The resultant circuit, drawn in the conventional way, showing the distributed capacity as a fixed condenser in each case indicates that we have a series of tuned circuits for each grid. The aerial, by the way, is a very short one, the set being designed for a particular length of aerial, and we find on examining the circuit that the aerial itself is tuned, or rather so tightly coupled to the first

Tuning Units

tion of S. G. BROWN, F.R.S.

tuned circuit that it becomes part and parcel of it. If too long an aerial were used of course the ganging would, we imagine, be upset.

We have already explained that in winding the coil one layer is wound along the former and the second layer returns on the top of the first. At the end of the first layer, and therefore the beginning of the second, a tapping is taken and this gives what is effectively



The medium-wave circuit expressed in a more conventional manner. The condensers represent the "lumped" coil capacity, which is of course, distributed. The centre-tap and lower end method of connection gives very tight coupling

a very tight coupling between circuits, as will be found on examining the theoretical diagram.

The end of the outer layer of each coil is earthed, the end of the first inner coil being connected to the aerial and that of the last to the grid. Thus, if each of the coils were carefully screened from the other, we

A tuner unit ready for mounting on a home-built receiver. Provision is made for two sets of tuned circuits—one for the H.F. stage and the other for the detector

should say that signals had to pass through a series of tuned circuits before reaching the grid.

Here, however, we come to a slight complication, for the coils are *not* screened and the total coupling effect must be rather a complex one. The wave-change switching merely changes over the sets of four coils on the medium band to the sets of two coils on the long, so we have fewer tuned circuits on the long wave than on the medium. Reaction is applied by reaction coils overwound on two of the four medium-wave coils in the second grid circuit and similarly to the long-wave coils in this circuit.

Actual Results on Test

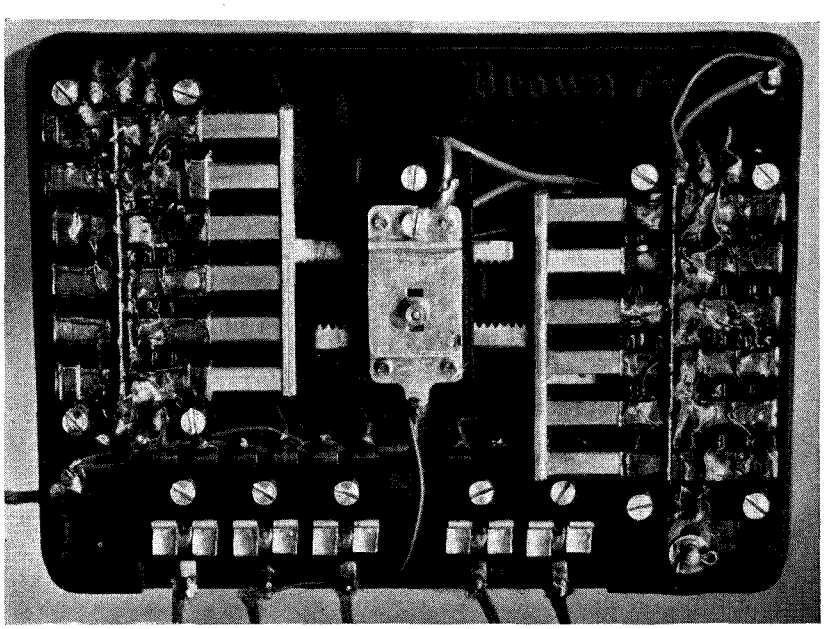
A practical demonstration at Acton, about ten miles from Brookmans Park, showed that London Regional spread over about ten channels, Acton being in what Mr. Brown called the swamp area for this set. We have heard a much higher degree of selectivity in such conditions with a modern multi-stage receiver, but for a very simple and inexpensive set the selectivity was good.

The great virtue of this tuner is its extreme compactness for when it is used the limiting size of the set would appear to depend only on the space occupied by the valves!

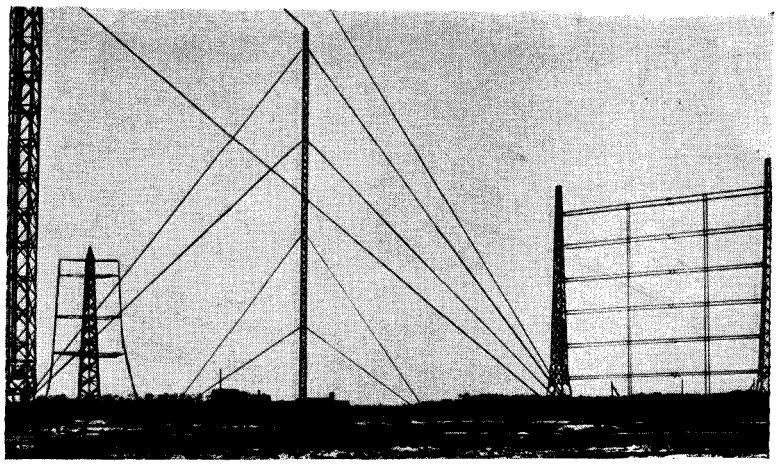
The tuner is available separately from the set; it will be sold to amateurs ready to connect to their own sets for £2 19s. 6d. The complete 3-valve receiver, screen grid, detector and pentode output, operating this tuner is illustrated on this page, and sells for £10 10s. It is designed to work from an 8 ft. aerial.

In our opinion the selectivity obtained with this tuner is considerably less than would be obtained on eight sharply tuned circuits, and as there are eight tuned circuits in this receiver we should consider the set

Continued on page 400



The rear of the tuning unit. On each side are six coils—four for the medium wave and two for the long. Notice the iron cores which are simultaneously moved in and out by means of a pinion and two racks. The central compression-type condenser is used for trimming



R. P. photo

This special photo shows clearly the aerials at Zeesen. In the middle and at the extreme left is the aerial for the long-wave transmitter; the others are for the short-wave transmitters, that on the extreme right being the South American directional wire.

Short-wave Reception Is Improving

says G. HOWARD BARRY in his notes on current conditions and interesting stations to be heard.

LAST MONTH I remarked that long-distance (reflected-wave) reception on 10 metres would probably be possible once more this year; I also commented on the fact that the Belgian station ON4AU had been in touch with North America on that wavelength.

This month I have more startling news to record. Not only has ON4AU been heard in Australia, U.S.A., and Canada, but Australian VK2LZ has carried out *two-way* work with the U.S.A. and Japan, and other Australians have been working with the States.

Conditions in this country do not appear to favour record smashing just yet, but it seems certain that startling developments may be expected. They will probably have been recorded by the time this appears in print.

20-metre Band Alive !

Concurrently with the improvement in conditions on 10 metres, as always, has come the corresponding improvement on the other bands. 20 metres has been alive with really "DX" signals from midday till midnight; "40," though badly hashed up by imitation telephony from European countries, carries its full weight of DX as well; and the 80- and 160-metre bands are behaving extraordinarily well.

So much for the amateur bands. The short-wave broadcast bands behave in practically the same manner as the nearest amateur band to each one, and it may be assumed from the above paragraphs that things have been good lately.

The long succession of B.B.C. relays of American programmes has given the word "reliability" a new meaning in this connection, and W8XK and W2XAD have been more consistent than I ever remember them before. Now and then a day of really bad conditions will spoil the run, but the general level has been excellent.

I will deal briefly with each band in turn, commenting upon the more reliable stations only.

14 metres: The sole occupant appears to be W8XK on 13.92, which is usually very good in the afternoons.

16 metres: W3XAL on 16.87 is often the loudest American station on the air. This band naturally fades out earlier than the 19-metre band, but is good until 5 p.m. as a rule.

19 metres: W2XAD (19.56), W8XK (19.72), and sometimes. W2XE (19.64) all good and reliable. Europeans (Budapest, Zeesen, Pontoise and Daventry) generally weak.

25 metres: Not much of interest here, except W8XK (25.27) and Winnipeg, CJRX (25.6). Pontoise, Rome and Zeesen often very strong. Band fades out at about 10 p.m.

31 metres: Interesting in the evenings, after 19 metres has faded out. W2XAF (31.48) and W1XAZ (31.36) both good, although not very reliable. Sydney (VK2ME) superlatively consistent on Sunday mornings and afternoons (31.28 metres). Lyndhurst (VK3LR) may be heard on weekday mornings, usually as strong as Sydney, but not nearly as reliable.

49 metres: Overcrowded but always interesting. Great profusion of Spanish-speaking stations in Central and South America, as well as ten or a dozen North Americans, too well-known to be dealt with separately. Activity of DX stations seems to commence at about 10 p.m., with the exception of the two South Africans (Nairobi and Johannesburg) who both come in from 6 p.m. onwards.

The trouble is that the European stations are tremendously strong during daylight, and it is difficult to find the weaker signals until they have faded out.

Individual stations worth looking for, on all the bands, and, in some cases, intermediate settings, are :

Singapore (ZHI), 49.92 metres; Panama City (HP5B), 49.75 metres; Bandoeng (PK-YDA), 49.02 metres; San Domingo, Dominican Republic (HI4D), 45.5 metres; Lima, Peru (OA4AC), 38.36 metres; Hamilton, Bermuda (ZFB), 29.83 metres; Buenos Aires (LSL), 19.02 metres.

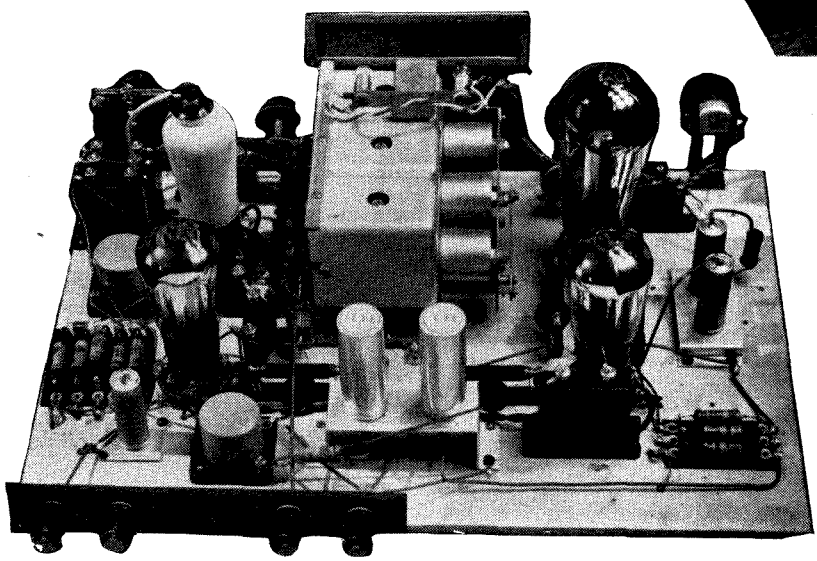
There are, of course, hundreds of commercial stations using telephony and sometimes relaying broadcast programmes. These do not work in the recognised short-wave broadcast bands, but may be found all over the dial.

Operating My 1935 Radiogram

By PERCY W. HARRIS, M.I.R.E.

This receiver, which has been built by Mr. Harris for his own personal use, was fully described in the May issue of "Wireless Magazine." When you have finished building your 1935 Radiogram you are invited to send us a photograph. All pictures published will be paid for at the usual fee of half a guinea

The Harris 1935 Radiogram is a real quality outfit. Every worth-while development to obtain real quality is incorporated, including the Tweeter loudspeaker and the piezo-electric pick-up. The cabinet too, is a fine piece of furniture and has compartments for storing gramophone records



PHOTOGRAPHS, wiring diagrams and the theoretical circuit published last month will have provided readers with most of the necessary information to construct this set, but there are still a few practical points of construction about which a little further information may be helpful.

Resistance Mounting

It will be noticed in the list of components that a 10-way resistance board is specified, whereas in the set two separate resistance boards, one with five and the other with three sets of holders, appear. The reason for this is that the base of the 10-way resistance mount is made of insulated material which can be cut very easily with a sharp saw, so that the two small strips required can be cut out of the single large one with great ease. One saves the expense of two separate holders.

If the 10-way strip is cut in the centre one half will do for the 5-way holder. A further small strip should be cut off the remaining piece (on the inside) so as to give a 3-way holder. All that is necessary now is the drilling of the two holes, one in each of the newly prepared strips, the other required hole being already there.

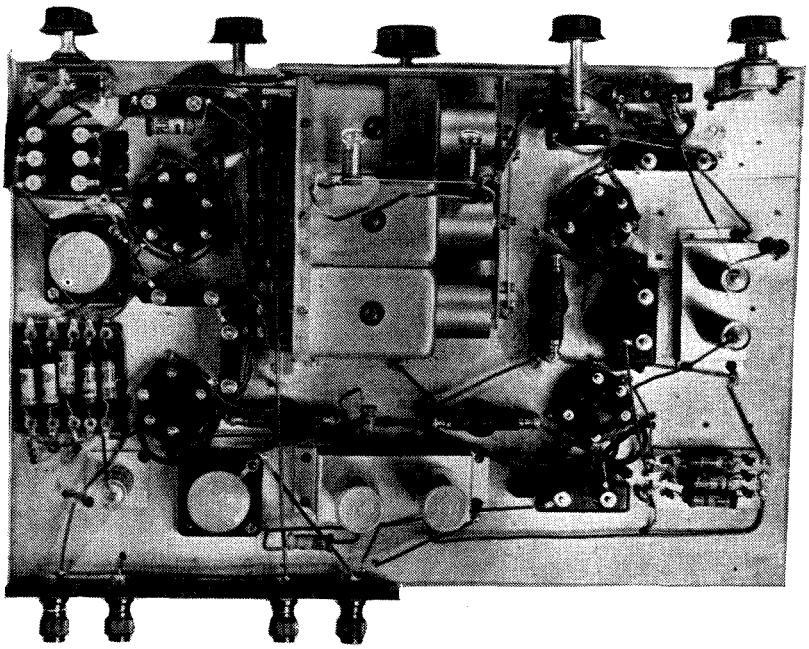
The next practical point concerns the symmetrical mounting of the various controls. The central tuning control, together with the wave-change switch and the volume control, have their positions automatically determined, but in order to present a symmetrical front I have arranged the reaction control on one side and the on-off switch on the other to fall on the lines passing from the centre of the tuning knob through the wave-change switch and volume control knobs respectively. As the brackets holding the reaction and on-off switch mountings are slotted it is very easy to adjust the heights to the correct level.

On-off Control

You may wonder why the on-off switch was not combined with the volume control so that when the volume control is turned to the lowest position the set can be turned off. This would, of course, have eliminated one control, but it has a very big practical disadvantage.

When you are using a " quality " set you will, in the main, use it on your local stations and you will have found the exact volume to suit your room. By having a separate on-off switch this volume setting can be left just as you like it, whereas if volume control and on-off switch are combined the volume has to be re-set each time.

If you *should* want to combine the two there is no difficulty because the particular make of volume control



A plan view of the Harris 1935 Radiogram; there are only a few wires on the underside. The controls—from left to right—are reaction, wave-change switch, tuning, volume control and, lastly, the on-off switch

used can be obtained with an on-off switch attached, so that when it is turned to the minimum position the set is switched off. The wiring would be quite simple; instead of going to the separate switch it would go to the switch fitted on the back of the potentiometer.

Baseboard Construction

The whole set, apart from the power pack, is made up on its baseboard and can be operated with ease outside of the cabinet; this is very useful for preliminary adjustment and test. After testing the knobs are taken off and the baseboard slid into the cabinet, whereupon the spindles will project through the necessary holes provided and the knobs can be put on again.

The tone-control knob, however, does *not* form part of this assembly, for the potentiometer is mounted directly on the cabinet after long flexible leads have been joined to its three points. After the loudspeakers have been screwed to the baffleboard these leads can be threaded through the upper hole marked in the diagram and connected when the baffle has been screwed into place.

It is advisable to screw the power pack to the base of the cabinet when it can be wired to the safety plug, which is also screwed to the base of the cabinet. It is convenient when wiring the main part of the set to leave long flexible leads connected to the on-off switch so that these can be joined up to the power pack *after* everything is in the cabinet.

Felt Mounting

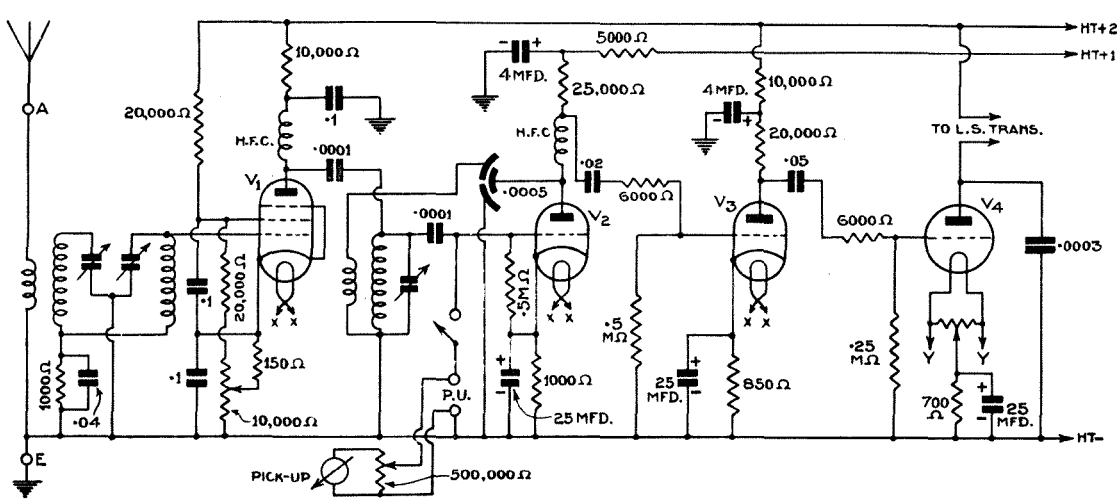
I have also found it convenient to place thin strips of felt underneath the baseboard of the set to isolate it from the shelf on which it stands.

For making the connections from the set to the power pack I have used good stout electric-lighting flex. I know you can purchase complete cables all nicely braided for this purpose, but unfortunately most of the cables I have seen have been made of fairly thin wire which, while quite suitable for high-tension leads and even for battery leads in a battery set, will not carry the heavy current necessary for the heaters of A.C. valves.

Heater Wires

It's not that the wires become unduly hot, but if they are too thin there is a voltage drop. Thus although your transformer may be giving the full 4 volts the voltage applied to the heaters themselves may drop considerably below this and spoil the efficiency of the set.

And now for practical adjustment of the set after it has been constructed. Before you place the receiver in the cabinet connect up the power pack, aerial, earth and loudspeakers (which you will already have mounted to your baffleboard) and try both the volume control and the reaction control.



The theoretical circuit of the set. The arrangement consists of a variable-mu pentode in the high-frequency amplifier, leaky-grid detector, which is resistance-capacity coupled to the first low-frequency amplifier and this in turn is again resistance coupled to a 2.5-watt triode output valve

Both should make the set oscillate when turned up to the full.

This may seem strange, but there is sound reason for it. The reaction control is very rarely used in this receiver—only when it is required to get a selectivity higher than that normally given. This, you may believe me, is very seldom !

Increasing Selectivity

The volume control operates on the variable-mu high-frequency pentode and when it is turned on to the full one gets the maximum magnification of this set. The gain here is so great that the small residual capacity in the high-frequency pentode is enough to feed back energy and make the set oscillate, so that this is really a combination of volume and reaction controls.

If now by manipulating this control you do not get sufficient selectivity you can turn the volume *down* a little on the volume control and bring up the strength of the signal again by careful use of the reaction control, which, of course, is in the detector circuit. The effect is to increase the gain and sharpness of tuning in the detector circuit while the set still remains stable.

Trimming

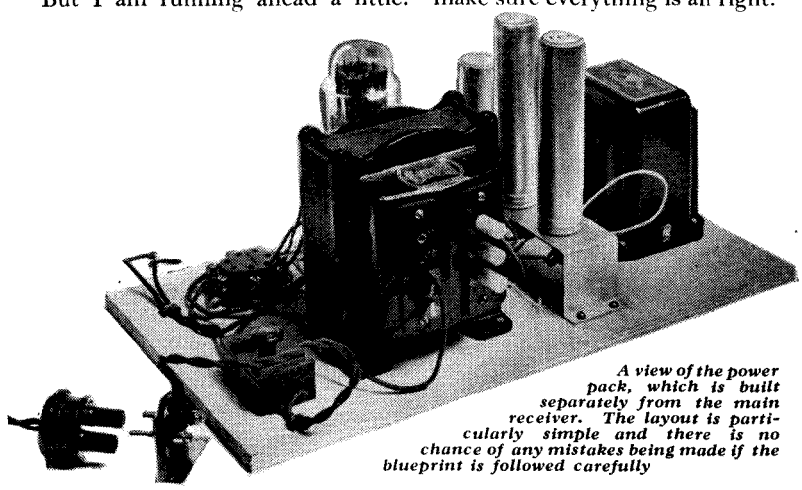
In Wimbledon—six or seven miles south-west of London—without the use of the reaction control Radio Paris is quite clear of Droitwich, but if an attempt is made without reaction to receive Deutschlandsender (which falls between Radio Paris and Droitwich) then there is interference. With careful manipulation of the reaction control and the volume control the German can often be separated from both Droitwich and Radio Paris.

On the medium waveband the set without reaction is as selective as many of the commercial super-heterodynes and here again it is rarely that one uses the reaction control. It is just as effective on this waveband for sharpening up the signals, as you will find on trying it.

But I am running ahead a little. Before we can make use of this control the set must be trimmed. With the permeability tuner you will be given a small box spanner, which will fit over the three nuts recessed in the top of the shielding on the tuner.

In the centre of each hexagonal nut will be seen a small screw and these two controls together form the trimming adjustment for medium and long waves. Do not play around with these adjustments too much—they are not intended for anything more than trimming and once you have trimmed the set they can, and should, be left alone.

The first step in trimming is to tune the set to a powerful station—your local for example—and then turn down the volume—with the volume control—till the signal is just audible. Now adjust the back and centre trimmers one after the other until you have brought the signal up to maximum. Then if necessary again reduce the volume to make sure everything is all right.



A view of the power pack, which is built separately from the main receiver. The layout is particularly simple and there is no chance of any mistakes being made if the blueprint is followed carefully

As you are trimming two circuits to a third you obviously will not touch the front condenser yet; the other two are being adjusted to match it. When you are sure that it is correct on one band turn to the other waveband and adjust its particular trimmer.

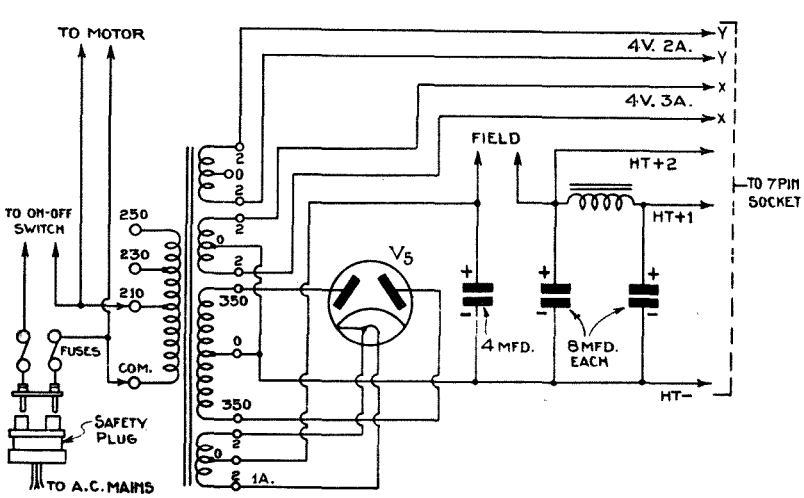
Scale Adjustment

There is no need for me to explain in detail the process of trimming as it is very clearly indicated in the leaflet accompanying the Varley tuner.

When both wavelengths have been adjusted in this way the set will be in a proper condition for working, but you will probably find that the actual wavelengths of the stations you tune in do not match the tuning-scale markings. The method of matching the scale marking to the actual wavelength is again clearly indicated in the permeability tuning leaflet and I need not spend time on explaining it here.

Motor Mounting

There are not many points requiring explanation in connection with the gramophone unit. The motor will be mounted according to the template provided and the positions of the needle cups, pick-up arm, etc., are all easily found, the pick-up arm being adjusted by means of the template provided. It is important,



The circuit of the power pack, which makes use of a valve rectifier. Fuses and safety plug are provided

COMPONENTS—OUR POLICY

COMPONENTS used in receiver designs published in "Wireless Magazine" are chosen for their suitability, efficiency and reliability. Their selection must not be taken to indicate any more than this, nor that other good-quality components are not equally suitable, save in a few cases clearly indicated where there are no suitable alternatives.

In a large number of cases there exist numerous good alternatives, as a study of the advertisement pages of this journal will show.

however, to make the connection of the pick-up lead correctly.

You will find the pick-up provided with a much longer cord than you need and this will have to be cut off short in order to connect it with the volume control potentiometer. When you cut the lead you will find not two side-by-side wires, but two leads made up of an exterior metallic braiding and a centre wire. The metallic braiding is earthed and automatically shields the inner or grid wire. Examine your diagram and join up the metallic braiding lead to that point of the potentiometer which is connected to the earthed pick-up terminal.

The simplest way of making connection with the metallic braid is to wrap a thin tinned wire round it and use a touch of solder, making sure, of course, that you do not apply the iron long enough to injure the inner wire; this latter can be separated from the outer "tubing" by pushing the braid back. The wires cut off from the pick-up lead can now be used to make the connections from the potentiometer down to the pick-up terminals.

You will observe when you examine the permeability tuner that when the tuning knob is turned so that the indicator points to "Gram" the pick-up is connected to the grid of the detector valve in *parallel* with the grid leak.

The Jubilee Radiogram has a very high gain, and there may be a very slight hum just audible when you are not receiving stations, but this will be unnoticeable directly signals are received. Absence of this slight hum in a set is not necessarily proof of good design, but often indicates that the loudspeaker does not go down low enough to reproduce it properly! With some mains, and in some houses where there is a tendency to induction, it will be found an advantage to use a metallised detector valve, and as in any case no harm can be done by using the metallised valve, it can always be employed with safety.

Detector Screening

If you are using a non-metallised detector valve and there is no hum trouble there is no point in changing it, but if there is more hum than you like you can either change it for a metallised valve or wrap the bulb round with tinfoil and join the tinfoil to the cathode point on the valve holder with a piece of wire, which will give just the same effect.

The tone control will be found very interesting and if you are after good quality you will rarely use it. There are times, however, when sideband splash gives rather irritating chatter from the very high frequencies which the set will reproduce satisfactorily. In such a case turn the knob to the right until the chatter ceases and there will be very little degradation of quality.

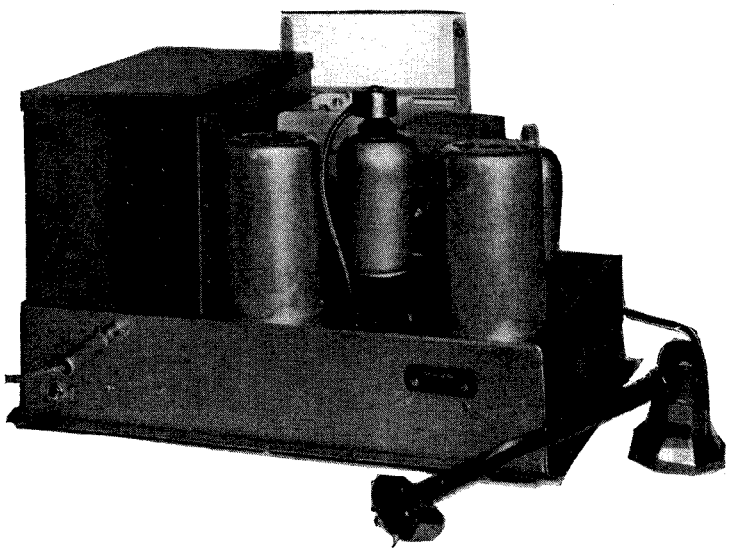
I am sure you will like this set and the quality will, I am equally sure, surprise you. It is a good station getter, too. I have identified some forty odd stations and hear a number that it is not possible to identify.

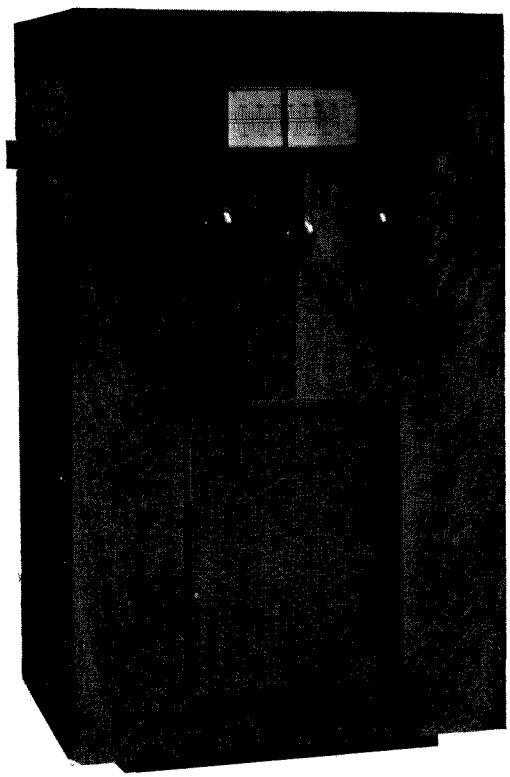
COMPONENTS NEEDED FOR THE HARRIS JUBILEE RADIOGRAM

	£	s.	d.
BASEBOARDS			
1—18 x 12 Metaplex, say ...		4	0
1—14 x 8 ditto, say		3	0
CABINET			
1—Peto-Scott de-Luxe 1935 Adaptagram model	6	10	0
CHOKES, HIGH-FREQUENCY			
2—Graham-Farish screened (single) type		5	0
CHOKE, LOW-FREQUENCY			
1—Varley, type DP16		17	6
CONDENSER, VARIABLE			
1—Graham-Farish .0005 microfarad differential reaction ...		2	0
CONDENSERS, FIXED			
2—T.C.C. .0001 microfarad, type 34		2	6
1—T.C.C. .0003 microfarad, type 34		1	3
1—T.C.C. .02 microfarad, type 25A		3	6
1—T.C.C. .04 microfarad, type T.C.C. 40		1	9
1—T.C.C. .05 microfarad, type T.C.C. 40 (mounted on baffle board)		1	9
1—T.C.C. .05 microfarad, type 25A		5	6
3—T.C.C. .1 microfarad, type T.C.C. 50		5	6
2—T.C.C. 1 microfarad, type T.C.C. 50		5	0
3—T.C.C. 4 microfarad, type 502		12	0
2—T.C.C. 8 microfarad, type 502		10	0
3—T.C.C. 25 microfarad, type C		7	6
GRAMOPHONE MOTOR			
1—Garrard gramophone motor, type 202A	2	10	0
HOLDERS, VALVE			
1—Benjamin, seven-pin		2	0
4—Benjamin, five-pin. (Note: One four-pin could be used for the output position, but the five-pin is suggested in case it should ever be desired to use a valve of the indirectly-heated type here.)		3	4
1—Bulgin, seven-pin (mounted on power unit for use with special connector between set and unit), type VH15		1	6
HOLDERS, RESISTANCE			
1—Bulgin 10-way group board, type C32. (Note: This is cut up in the manner to be described, to form one 5-way unit and one three-way.) ...		1	9
3—Graham-Farish Ohmite holders horizontal type		1	6
LOUDSPEAKERS			
1—Rothermel "Tweeter" loudspeaker, type 155	1	1	0
1—Rola excited-field speaker, Model F7-1250-00 with 1250-ohm field winding	2	7	6
PICK-UP			
1—Rothermel-Brush piezo-electric pick-up, de Luxe model ...	4	4	0
RESISTANCES, FIXED			
1—Amplion 150 ohms		1	0
1—Amplion 700 ohms		1	0
1—Amplion 850 ohms		1	0
2—Amplion 1,000 ohms		2	0
2—Amplion 6,000 ohms		2	0
1—Amplion 5,000 ohms		1	0
2—Amplion 10,000 ohms ...		2	0
3—Amplion 20,000 ohms ...		3	0
1—Amplion 25,000 ohms ...		1	0
1—Graham-Farish ¼ megohm, Ohmite		1	6
2—Graham-Farish ½ megohm ...		3	0
1—Varley 40 ohm, centre-tapped, type CP75		1	6
RESISTANCES, VARIABLE			
1—Rothermel-Centralab 10,000 ohm volume control		3	9
1—Rothermel-Centralab 25,000 ohm. (Note: This is mounted on the cabinet front.) ...		3	9
1—Rothermel-Centralab ½ megohm ditto (mounted on the motor-board). (This one should be obtained with a knob: the previous two are to be fitted with the spare knobs supplied with Varley tuner.)		3	9
SUNDRIES			
2—Peto-Scott needle cups, projecting type, say		1	6
2—Dial-light bulbs, 5- or 6-volt type			
2—Peto-Scott brackets for mounting reaction condenser and on-off switch. (Volume control is mounted on spare bracket supplied with Varley tuner.)			
1—Peto-Scott 3-way electrolytic condenser mounting bracket, standard type			
1—Peto-Scott 2-way ditto, special type			
1—Peto-Scott single-way ...			
6—Belling and Lee terminals, type R, markings as per diagrams		3	0
1—Bulgin mains plug and socket, type P12		2	6
1—Bulgin seven-pin cable plug, type P37		2	0
1—Bulgin safety fuse holder and fuses, type F19		2	6
1—Terminal strip, 9 x 1½ in. ...			
1—ditto, 3 x 1½ in.			
Supply of wire, screws, sleeving, etc.			
SWITCH			
1—Bulgin, type S91, rotary on-off		1	9
TRANSFORMER, POWER			
1—Heayberd special model (quote name of set when ordering) ...	1	13	0
TUNER			
1—Varley Permeability Tuner, type BP100, with radio-gram switch, and three spare matching knobs (i.e. two in addition to the one spare knob normally supplied)	3	10	6
VALVES			
2—Osram MHL4	1	7	0
1—Osram VMP4, 7-pin base ...		17	6
1—Osram PX4		16	6
1—Osram MU12		15	0

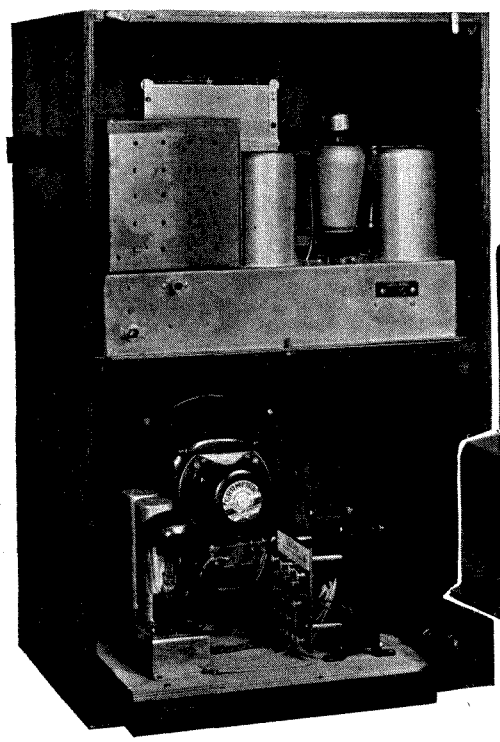
A Good Cabinet for the 1935 Stenode

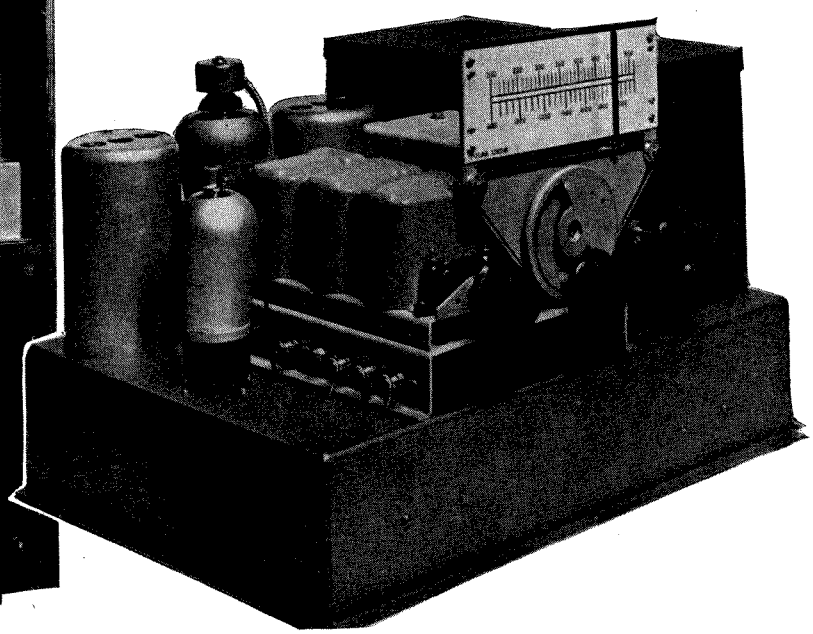
The 1935 A.C. Stenode, designed for "W.M." by Paul D. Tyers, was described in the April and May issues of "W.M.," of which a few copies are still available, price 1s. 3d. post paid, from the publishers, George Newnes, Ltd., 8-11 Southampton Street, Strand, W.C.2





The C.A.C. cabinet for the 1935 A.C. Stenode is characterised by clean and essentially modern lines (it was built from sketches made for us by Mr. Tyers), and the internal arrangement conforms to the electrical requirements of the Stenode circuit. The price is £3 10s.





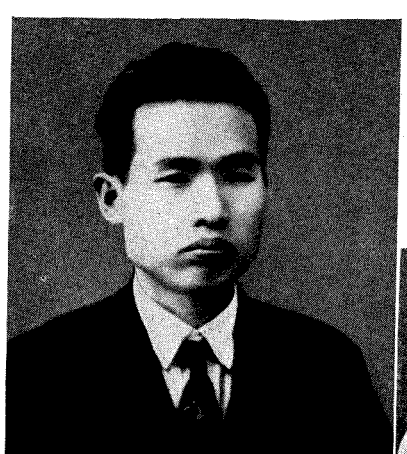
Television Notes and News

A Spanish scene in No. 1 studio at the Crystal Palace being taken by the Baird intermediate-film process

The Truth About Wavelength and Definition

By P. WOODWARD

A LOT of nonsense has been talked and written just lately about the possibility of achieving ultra-high definition without the need for correspondingly ultra-short waves. Let us examine some of the simple fundamental facts and see what complete rubbish it is to talk, as some have done, of 400 and even 500 lines on waves such as 9 metres.



Professor Kenjiro Takayanagi who might be truthfully described as Baird's counterpart in Japan

The figures which follow are offered on the authority of one of the foremost television engineers in this country; they are not based upon theory alone, but on a practical experience which is probably unrivalled.

First, the question of the modulation frequencies involved by various numbers of scanning lines. Here most people go wrong, for they imagine that if they work out the number of "picture points" which can be covered by a scanning spot of a certain size, and multiply this by the number of pictures per second they will arrive at the highest modulation frequency which will be required.

Dr. Schröter, the chief of the television section at the German Telefunken laboratories, where big strides in television development are taking place

Actually this is a fallacy because it assumes that the modulation is in the form of a sine-wave current. When it is necessary to reproduce small details in sharp black and white contrast the current variation must be rectangular in shape, and this demands the presence of sundry upper harmonics of the main frequency. If the necessary provision is not made for transmitting these higher frequencies the resulting picture is no better than that which could be got with a lower scanning frequency.

A reasonable assumption on these bases is that scanning in 180 lines calls for modulation frequencies up to 1 megacycle as the bare minimum, 240-line scanning demands frequencies up to 2 megacycles, while for 400 lines it is necessary to go up to 5 megacycles at least.

Wavelength Limits

Next there is the question of the longest wavelength upon which such modulation frequencies may be transmitted. Here it must be explained that the aim is always to use as long a wave as possible, simply because as the wavelength is reduced difficulties with interference from motor-car ignition circuits and "blind spots" produced by hills increase rapidly. In practice it is found that below about 6 metres these troubles become much more acute.

Unless the transmitter is designed so as to be extremely wasteful of power the maximum wave for 180-line scanning is about $7\frac{1}{2}$ metres, for 240 lines it is 5 metres and for 400 lines the wave must go down to $1\frac{1}{2}$ metres! If appreciably

longer waves than these are used not merely does the transmitter become very inefficient and costly in relation to the actual amount of power it succeeds in radiating, but grave difficulties are encountered in the design of the receiving circuits.

◇ ◇ ◇

Here are the long-awaited details of the new Cossor giant cathode ray tube: the size of the screen is even bigger than rumour had indicated—the tube is 12¼ inches in diameter—and the overall length is 26 in. In common with other tubes of this magnitude, it demands quite a high anode voltage, of the order of 4,000, but of course the current required is extremely small and this is not in fact so alarming a requirement as it might appear at first glance.

Interesting Tubes

The type number of this tube is 3272 and it is one of a group of three now listed by Cossor. Type 3271 is a much smaller size (diameter 6⅜ in., length 18¾ in.) while type 3274 comes in between, being 22 in. long and 10 in. in diameter. Both the smaller models require only 3,000-volt supplies.

All three have been designed expressly for high-definition television and employ the electrostatic method of focusing in order to obtain a sharply-defined spot unaffected by the modulation. Two types of screens are available, one (type J) giving a pale blue response closely resembling black and white, and the other (type H) providing a sepia-toned picture.

◇ ◇ ◇

Another interesting piece of news takes the form of a very well-authenticated rumour that Baird Television, Ltd., is preparing a cathode tube outfit for amateur use. It seems that this will consist of a tube giving a clear and bright picture measuring 3½ in. by 4½ in. made up into a self-contained unit incorporating the necessary mains supply, synchronising and time-base circuits.

The price is expected to be 20 guineas, and apparently the idea is that the amateur shall make up for himself just the needful radio receiver to operate the viewer. The advent of an outfit like this with its circuits already adjusted should make it a comparatively simple matter to set up a high-definition receiving apparatus.

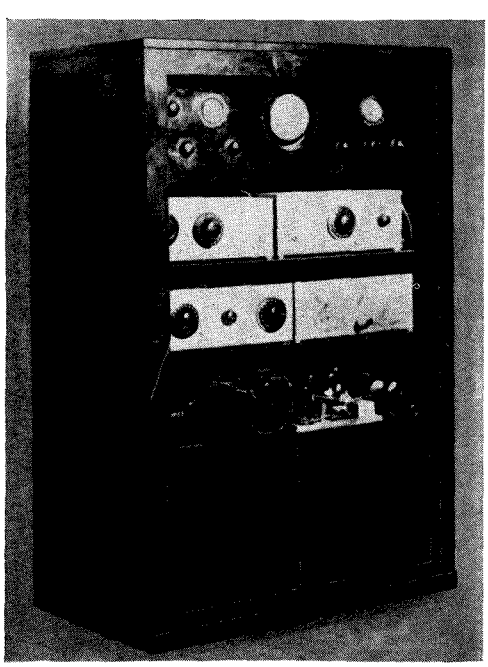
◇ ◇ ◇

The German high-definition service appears to have made a very good start, and seems to be covering the main Berlin area somewhat better than certain critics imagined possible. It is particularly interesting to note that the reports so far received indicate that as yet no definite dead-spots have been found anywhere in the region served.

◇ ◇ . ◇

And still we don't even know whether it is to be the Alexandra Palace or not! Apart from the irritation which the keen experimenter feels whenever he reflects upon the fact that there is a complete television transmitter standing more or less idle all the while at the Crystal Palace, the delay is regrettable from another point of view: it is imposing a heavy handicap on the would-be manufacturer of television receivers.

A fine view of the huge Broadcasting House of Berlin from which high-definition television transmissions are broadcast twice a day



Here is the trial receiver built by Professor Takayanagi in Japan. The East is already hard on the heels of Western television ideas!

Overcoming Difficulties

The absence of even an experimental public service at known hours means that it is extraordinarily difficult for him to get on with the design of his intended instruments. In spite of these obstacles it seems that several firms are making quite serious plans, Edison-Bell especially.

◇ ◇ ◇

Some mischievous person has, I hear, been drawing a series of geographical sections in all directions from the Alexandra Palace: contrary to the "semi-official" view it is apparent from these sections that the high ground on which Sydenham stands will almost certainly cast a heavy "shadow" over quite a large and densely populated area if the Alexandra site is chosen.

How Berlin's Television Will

Compiled from Information Sent by Our Continental

A SELECT number of about 120 people assembled in the big conference hall of the Berlin Broadcasting House on Friday, March 22, 1935, to witness the opening of the world's first regular high-definition television service.

The German Ministry of Propaganda, the Post Office, television firms and such well-known television pioneers like Herr von Mihàly were present, together with representatives of the German and foreign press. A semi-circle of seven television receiving sets had been provided to enable the meeting to follow the programmes.

R.P. photo.

The round aerials of the ultra-short-wave television transmitter are erected on the top of the Radio Tower at Berlin-Witzleben

The Director General of German broadcasting, Herr Eugen Hadamovsky, addressed the audience and pointed out that television would never be a competitor of the cinema theatres. The Fernseh-A.G.'s invention of suitable television projection receivers enabled every modern cinema to present the latest television programmes on screens of the cinemas as well as ordinary films. He also said that the coming of television would provide home constructors and the journals catering for them with a new lease of life.

The representative of the Post Office, Dr. Banneitz, the head of the television laboratories, proclaimed the welcome news that television lookers would not be asked to pay a special television fee provided they had an ordinary listening licence. The representative of the German Broadcasting Company's chief engineer, Herr Hoffmann, stated that what was happening in Berlin on that day was, in practice, what Great Britain intended doing this autumn.

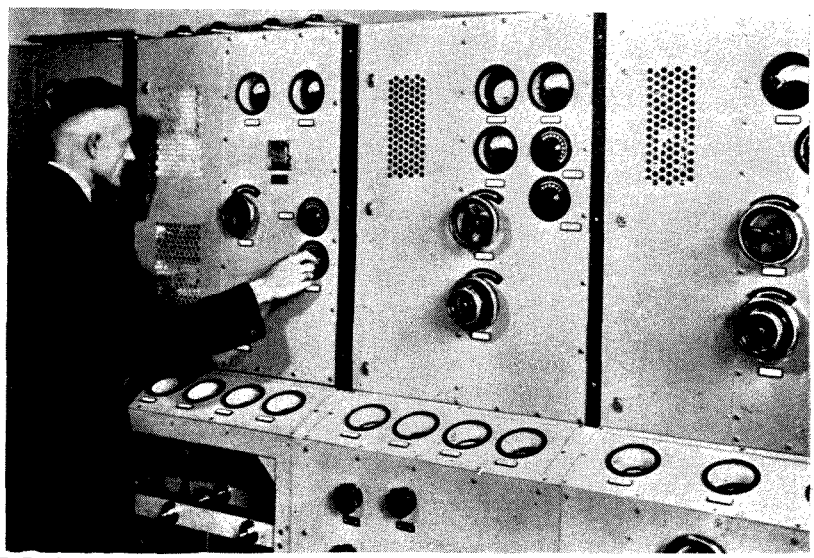
A programme lasting an hour and a half followed. The Deputy Director of German transmissions, Herr Boese, opened this memorable programme with the words : " I hereby open the world's first regular high-definition television programme service! " This was followed by a repetition of part of Herr Hadamovsky's speech and his reading of a telegram to Herr Hitler. Other films followed.

It is understood that mass production of suitable receiving sets is to start so as to provide the Berlin lookers with sets in greater numbers by the time of the forthcoming German radio exhibition in August. Berlin television lookers at present number a few hundreds. This statement was made by Herr Hadamovsky in his speech.

Berlin's television transmitter has been erected at the Radio Tower, Witzleben, a residential suburb of Berlin where, besides the German radio headquarters, the exhibition grounds are also situated. The plant consists of two ultra-short-wave transmitters, one of which conveys the visual, the other the sound effects. The aerials belonging to this plant have been set up at the top of the Radio Tower. The transmitter has a range of twenty-five miles, so that the whole of Greater Berlin is able to listen and look-in to television.

Economy Measure

To provide television for the whole of Germany a considerable number of transmitters are needed. On grounds of public economy, however, a relatively small number of television transmitting stations, each with a large range, will be erected. Since the range is determined by the height of the aerial, it has been decided to erect these on the tops of very tall masts on flat land and on the highest hills in mountainous districts.



R. P. photo.

The transmitter used for high-definition television at Berlin Broadcasting House was developed by the Telefunken concern

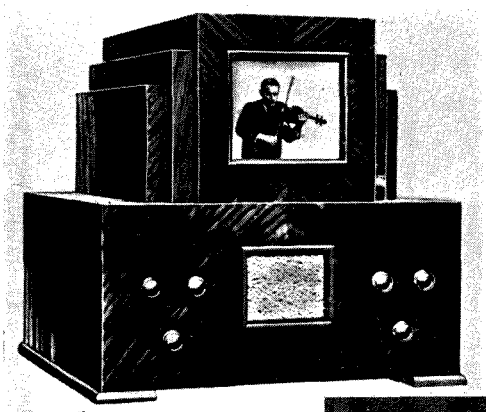
Develop

Correspondents

For Central Germany the Brocken in the Harz mountains seems a likely site for a television transmitter. If experiments carried out there prove successful, a transmitter with a range of 60 to 90 miles will be erected. The German Postal Administration has commissioned the construction of a television transmitter which, if justified by tests taken in the meantime, would be set up on the Brocken in the summer of this year.

Gulliland photo.

The scene at the opening of the world's first regular high-definition television service. The Director of German broadcasting, Herr Eugen Hadamovsky, is seen addressing the guests of honour. Note the television receivers and the bust and picture of Herr Hitler



R.P. photo.

The combined radio and television receiver manufactured by Loewe Radio

Tests already carried out on the Brocken have shown that the long-distance cables for carrying sound are not suitable for carrying the frequencies necessary for television. Recent research conducted by the German Postal Administration in conjunction with the cable industry has resulted, however, in the manufacture of a special type of cable suitable for television. A cable of this kind will shortly be laid in Berlin.

The next step will be to experiment with long-distance relaying of television by means of cables. If that proves successful, it should then be possible, as with the present sound apparatus, to relay visually the scenes at any place, first to the transmitter and then over the ether to the radio audience.

The development of cables for television should also prove serviceable for television conversation. For the present, however, owing to the high costs involved, television conversation will only be possible in exceptional cases.

Television connection between the largest towns is the utmost that can be looked for in this respect. The construction programme represented by the plans mentioned above may well need years to realise. Despite the large expense involved, the German Postal Administration intends to further with the utmost vigour the plans outlined here in the interests both of science and of the German nation.

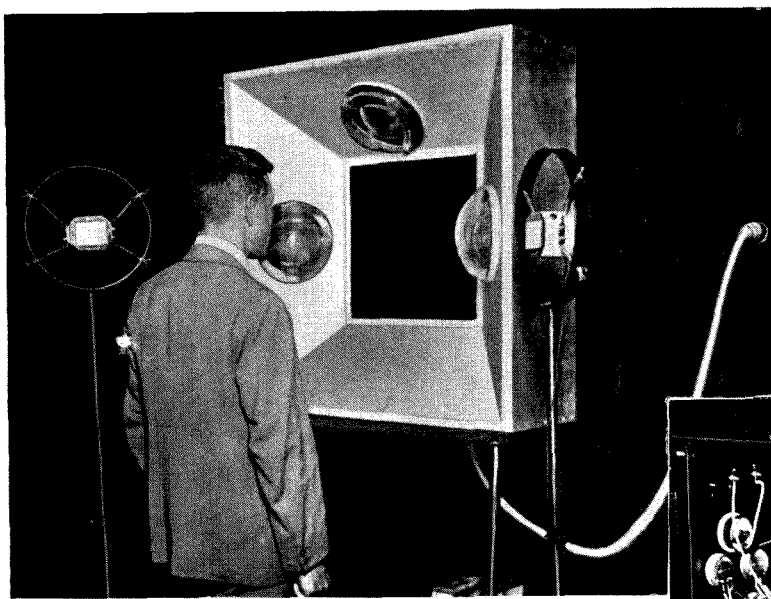
R.P. photo.

Telefunken's combined radio and television receiver showing the cathode-ray tube removed from the opening above the loud-speaker fret

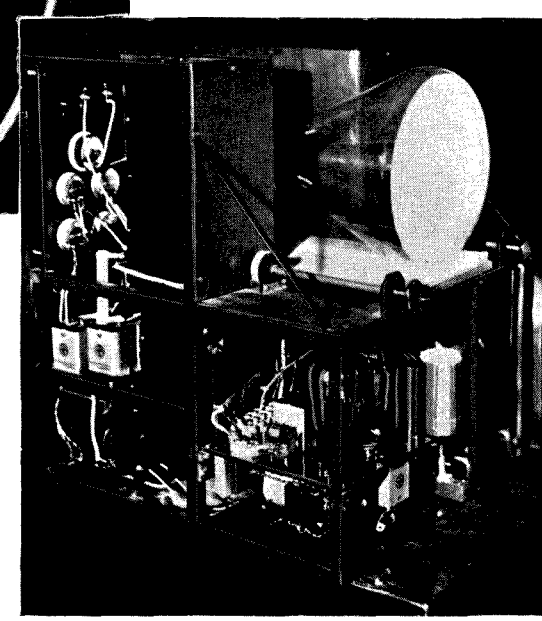
At the present time regular television transmissions are given twice a day—in the morning and in the afternoon. These serve the essential purpose of giving both television concerns and official circles the opportunity of trying out television receivers, testing reception conditions and to determine the most suitable wavelengths.

The television apparatus at present installed for the transmission of films is intended purely as a "sample plant"; a big development is anticipated.

The Postal Administration—the supreme control for television in Germany—has already installed special apparatus for televising just the heads and shoulders of artists and "notable people."



Scanning in one form or another is common to all systems of television and a grasp of its general principles is an essential preliminary to understanding the subject as a whole. This month the Technical Editor completes his simple explanation of this fundamental process



Scanning In Practice

A Simple Explanation by G. P. KENDALL, B.Sc.

Above (right) is the chassis of the Telefunken receiver using a cathode-ray tube for reception of high-definition television. The other is a photograph from Japan, showing the arrangements used for transmitting a close-up view by the flying spot system. Here the scanning spot reaches the face of the artist through the large rectangular opening

WHEN we left the subject of scanning last month, we had arrived at a point where we could visualise something in the nature of a telescope fitted with a photo-electric cell behind the eye-piece and set to "scan" a scene in a series of regular sweeps.

That is a conception which must not be taken too literally. It is helpful in grasping the general principle, but it is scarcely suited to the requirements of modern television. For one thing the amount of light picked up by the telescope would hardly be large enough to produce an adequate output from the photo-electric cell, and for another the mechanical difficulties would be very considerable.

In concluding this brief survey of the basic principles of scanning I intend to explain how the process is actually carried out in practice, but before making a start, I think it would perhaps be as well to acquaint the reader with the simple arithmetical facts involved.

We must first realise that the process of scanning is one of extreme rapidity. Even in the low-definition transmission of the present B.B.C. service, the equivalent of our telescope device has to cover the whole picture area in a series of thirty sweeps and complete the operation twelve and a half times in every second! Such speeds quite obviously rule out anything so cumbersome as that telescope idea.

Matters become even more difficult in the case of high-definition work. Here the scanning is done in a much greater number of finer lines (hence the greater amount of detail which in itself constitutes "high definition") and the picture frequency is also increased.

Instead of the picture area being swept in only thirty lines, the number may go up to 180, 240, or more, while the frequency with which the process is completed, is usually twenty-five times per second.

Marked Improvement

The improvement in picture definition resulting from an increase in the number of scanning lines will readily be understood when it is remembered that as the number of lines is increased, *the width of each line is reduced.* This is the limiting factor deciding the fineness of the detail which can be transmitted; only such details as are at least as wide as the scanning line can be reproduced accurately.

The object of raising the picture

frequency above the twelve-and-a-half-per-second rate, characteristic of the low-definition system, is to reduce the phenomenon we call flicker. At the lower rate this is decidedly noticeable and makes the picture distinctly tiring to watch; some improvement here is essential if television programmes of any length are to be watched.

Although persistence of vision comes into operation to some extent at the comparatively low frequency I have mentioned, the illusion is not perfect and a higher rate is necessary to give the eye the sensation of a continuous picture.

Adopted Rate

It is probable that a picture repetition rate of twenty-five per second will ultimately be adopted for the high-definition service; this means that the scanning device must make its 180 or more complete sweeps across the picture area twenty-five times in every second and here we approach a rate of movement which is nearing the limits feasible by mechanical means.

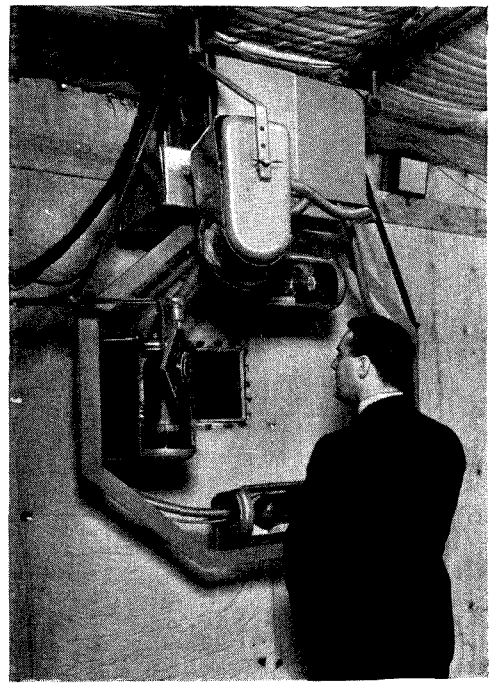
One hundred and eighty multiplied by twenty-five gives a figure of 4,500, and that is the number of scanning movements which must be made in each second; clearly a very difficult problem.

Mechanical methods are, therefore, tending to disappear and be replaced by purely electrical systems of scanning. The older methods are much simpler to understand, however, so I propose to start by considering a typical one.

This is the arrangement used by the B.B.C. for thirty-line transmission. The essential feature of this method is the use of a darkened scene traversed by a moving spot of light in the series of lines which is characteristic of all scanning systems.

One of the advantages of this method is that it dispenses with telescopes or other devices for focusing the light from any particular part of the scene upon the photo-electric cell. Since at any given instant the only light coming from the scene is that which is reflected back by the part which the scanning spot is then covering, it is sufficient merely to set up the cell facing the whole scene without any special optical device to limit its field of view.

It thus becomes possible to use a number of cells and so obtain a considerably larger current output for transmission. The whole arrangement is also much more flexible and the cells can be grouped in various positions to produce any desired lighting effect to suit the subject.



Baird photo

Compare this with the Japanese picture opposite: it shows a close-up being transmitted by the flying spot method at the Baird studios. Note the similarity of the photo-cell and microphone arrangements

The mechanical devices involved are comparatively simple. For example, in one form the main scanning device is a large revolving drum carrying upon its rim a number of small flat mirrors. Upon these a narrow pencil of very intense light from a powerful arc is focused and the mirrors are so set that as each passes through the light beam it throws a spot of light upon the scene, across which it sweeps in a straight line.

Mechanical Scanning

As any individual spot leaves the scene at the end of its sweep another enters at the opposite extremity and makes another traverse along a line just beside that covered by the previous one, and so the process goes on until the whole picture area has been scanned. At this point the drum has made one complete revolution, and on starting the next turn the cycle of events begins to repeat itself.

A moment's thought will show that the drum must carry as many mirrors as there are to be scanning lines in the picture system, and it must make as many revolutions as there are to be complete pictures per

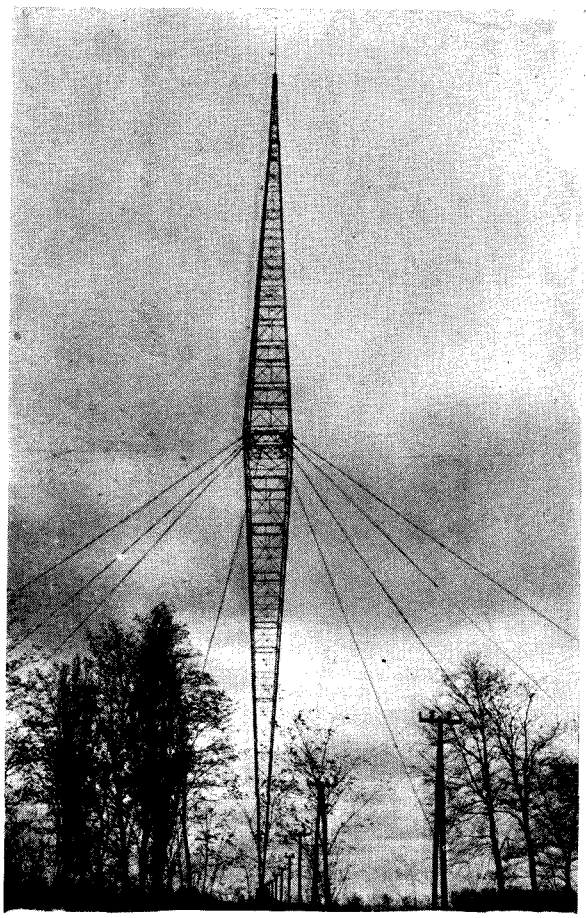
Continued on page 399

Baird photo

Much of television practice is closely akin to the technique of the making of talkies. This photo was actually taken at the Crystal Palace, but it strongly suggests Hollywood

Fading and the Non-fading Aerial

By J. H. REYNER, B.Sc., A.M.I.E.E.



N.P. photo

A typical modern type of anti-fading aerial—this is actually the mast at Budapest. It is 314 ft. high and of American design. Note the small extension at the top

IF you are one of the fortunate listeners who reside within twenty or thirty miles of your local station, fading is a problem which does not seriously concern you. When you listen to foreign programmes you will no doubt be troubled and perhaps irritated by the variations in strength and quality of the signal, but you always have your local station to fall back on. How would you like it if your local programme behaved in much the same way?

Yet many listeners are in this unfortunate position, not only in this country but abroad, particularly in America, where long distances have to be covered and a range of a few hundred miles is nothing very alarming. In such circumstances you will agree fading becomes a real problem and broadcast engineers for some years have been endeavouring to find means of reducing it.

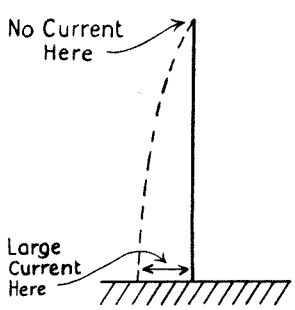


Fig. 1.—A diagram showing the distribution of current in an ordinary type of transmitting aerial

Diversity Reception System

Of course, special spaced aerials can be used at the receiving end. This system is used, particularly on short waves in what is known as "diversity reception," and the success of the *Five Hours Back* programmes which have been relayed on Saturday afternoons for some time now shows how effective this form of reception can be. The ordinary listener, however, is not in a position to go to such lengths; the only remedy as far as he is concerned is to transmit in the first place the signal which will not fade.

Such a state of affairs sounds ideal. Can we do it? Complete suppression of fading is *not* possible, but it has been known for some time that certain forms of aerial will give better service than others and within the last few years these special types have come rather into prominence. Upwards of a dozen stations in America have been fitted with non-fading radiators and more recently a number of stations on the Continent have been similarly equipped, two of the most interesting being at Breslau and Hilversum. The new Irish Regional Station now being built at Lisburn is to have an aerial of this type.

Why Signals Fade

If we are to understand how a non-fading aerial can work we must know the reason for fading. Most readers will be aware that this unpleasant phenomenon is due to reflection from the upper atmosphere. Wireless waves are radiated from the transmitter in all directions, not only to all points of the compass but also at all angles. Some of the waves travel along the ground, and this ground ray dies away fairly rapidly. The ground ray constitutes, in fact, the daylight range of the station, for the sky wave is not really effective until after dark.

When darkness falls the upper atmosphere settles down to a fairly steady state, leaving an electrified layer some 40-50 miles up. The wireless waves which leave the transmitter in an upward direction travel outwards until they meet this electrified layer, which reflects them back again down to earth. They reach the ground at a point depending on the angle at which they left the aerial. Those waves which leave at a high angle

come down fairly soon, while those which leave at a low angle come down hundreds of miles away. It is these latter waves that are responsible for long-distance reception obtainable at night.

Now there are two kinds of fading. The first kind is due to interference between the reflected wave and the ground ray. One wave has travelled along the surface of the earth and the other has gone up to the heavens and back again, and it may come back from its lengthy journey either in step or out of step with the ground wave according to circumstances.

What happens in practice is that circumstances are continually changing in the upper atmosphere and therefore the two waves are sometimes helping one another and sometimes opposing, so that the combined strength rises and falls. If the sky wave is approximately equal to the ground wave we shall get a variation between twice the normal strength and a complete wipe-out.

Introducing a Second Kind of Fading

As we go farther away from the transmitter the ground wave becomes weaker and weaker, leaving the sky wave in control, and a second form of fading comes in here due to interaction between two or more sky waves which have arrived at the distant points by slightly different routes. This long-distance fading is beyond the control of the transmitter altogether. No alteration in the aerial will make any difference to this, and we shall leave it out of any further consideration.

The broadcast engineer, however, is concerned mainly with what he calls his " service area " —an area immediately surrounding the station and extending for a radius of two or three hundred miles with modern high-power transmitters. This is a range within which the ground ray is still effective, for it is this which provides the reliable service. The sky wave is altogether too variable to be considered reliable.

Sky-wave Interference

Now as we have just seen, towards the limit of the service area, where the ground wave is getting a little weak, interference begins to be experienced from the sky wave and fading ensues. Is there any way of checking this action ? We cannot stop it, but we may be able to increase the critical range at which fading first becomes troublesome.

This can be done by a combination of two methods. We can—

(*a*) Increase the intensity of the horizontal radiation from the transmitting aerial so that the ground wave is stronger.

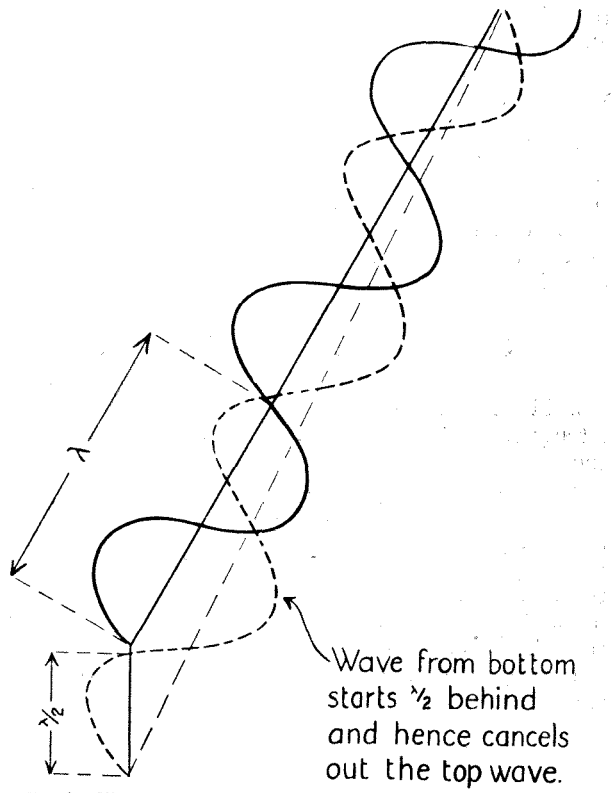
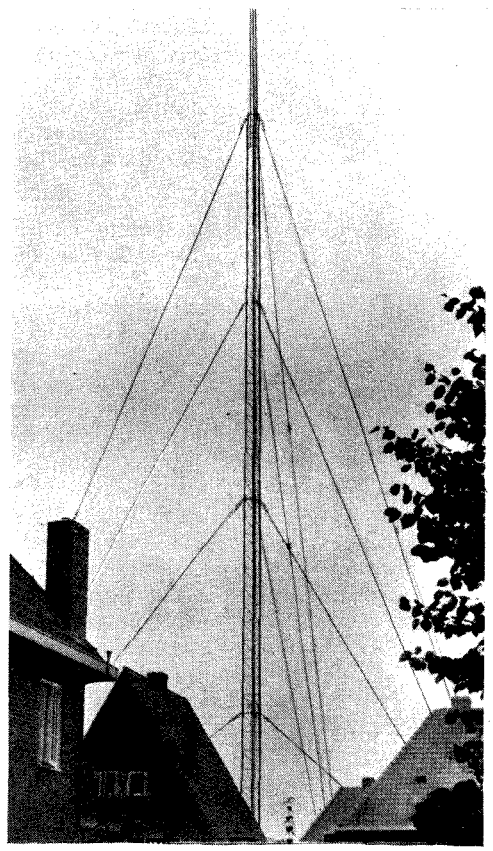


Fig. 2.—Illustrating the cancelling action of upward radiation with a half-wavelength aerial



Gullland photo

This is Hilversum's mast-aerial. This mast was erected by Philips and, like Budapest, the mast itself is the aerial. This aerial is of the half-wavelength type

(*b*) Reduce the upward radiation so that the sky wave is minimised.

There is, fortunately, a method of achieving both these desirable results at one and the same time, and although the process can only be carried a small way it does result in a marked increase in the service area of the station. Moreover, this remedy, at first sight, is a comparatively simple one. *We have merely to increase the height of the aerial.*

Aerial Design

Let us glance for a few moments at the normal procedure in designing an aerial. An aerial is an oscillating circuit containing inductance and capacity just like the tuning circuit of a receiver, and current rushes up and down the vertical wire from top to bottom of the aerial many hundreds of thousands of times per second. The difference is that owing to the long length of the aerial wire the current is not the same at all parts. Usually the maximum current is obtained at the bottom of the aerial and the current gradually decreases as it goes up until at the top

there is no current at all. Fig. 1 represents diagramatically the sort of way in which the current varies.

Now because of this uneven distribution of current we have to consider the total radiation as being made up of numerous little aerials situated successively down the aerial. Moreover, when we consider the radiation in an upward direction it will be clear that the wave produced by the current at the bottom of the aerial has farther to go than a corresponding wave produced at the top. Consequently, although in a horizontal direction the radiation adds up, it does not do so as effectively in the upward direction.

Cancelling Out Upward Radiation

Suppose we made the aerial half a wavelength long. Consider the radiation in a vertically upward direction. At any one instant there is a little bit of radiation from the top of the aerial and at the same instant a similar radiation starts from the bottom of the aerial. In time this radiation from the bottom of the aerial will arrive at the top, but as it has already had to travel half a wavelength it will be in opposition to the wave leaving the top. Consequently the two will cancel each other out and there will be no radiation in the upward direction. This is shown in Fig. 2.

Hence, if we make the aerial half a wavelength long we shall greatly reduce the upward angle radiation and

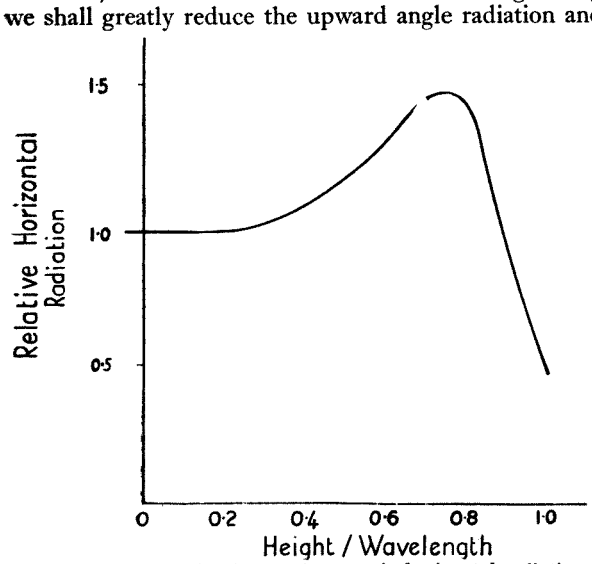


Fig. 3.—A curve showing the increase in horizontal radiation as the height of the aerial is increased

consequently the sky wave will get a very poor start. We also find on analysis that the horizontal radiation has increased—this is to be expected since we have a larger effective aerial height. In fact, we can if we like go beyond half a wavelength with still further improvement. Here the dead vertical radiation begins to increase again, but the radiation at intermediate angles is reduced to zero, and this has still more effect on reducing fading because it is the wave leaving the aerial at an angle of about 60 degrees which is responsible for the fading at the edge of the service area. Actually the optimum conditions appear at about 0.6 of the wavelength.

This is the basis of the non-fading aerial, and Fig. 3 shows the improvement which can be obtained. The factor, Relative Horizontal Radiation, is actually the horizontal field strength divided by the square root of the power, which is really the criterion that concerns the broadcast engineer, because he is anxious to produce the greatest horizontal radiation for a given power. It will be seen that with an aerial just over 0.6 of a wavelength long there is nearly 50 per cent. increase in horizontal radiation.

The best conditions are really obtained by arranging the maximum ratio between the ground wave and the sky wave. This is unfortunately not obtained when the ground wave is a maximum, and it pays not to increase the aerial height quite so much but to stop short at little over half a wavelength long. Then, although the ground wave is not quite so strong as it might be, yet the sky wave is proportionally still less and the best ratio is obtained around this point. The subject is a little involved, but those who are especially keen to know more should consult the literature quoted at the end of this article.

"Tall" Theories in Practice

If this improved radiation can be obtained, why do we not all adopt it? The answer is one simply of economics. A half wavelength aerial is a fairly extensive structure on ordinary broadcast wavelengths. Even on 400 metres it would have to be 650 ft. high. The highest masts in this country, at Rugby, are only 800 ft. high, and anyone who has seen those tall silent sentinels, often with their heads in the clouds, will appreciate what height means. The ordinary broadcast aerials are not more than a few hundred feet, those at Brookmans Park being 200 ft. high.

The various masts which have been tried out in America and Germany are of these large heights. The WABC station at Wayne, New Jersey, is 670 ft. high and is of the guyed cantilever type. It consists of a square section mast of gradually increasing cross-section until little under half way, at which point it is supported by stays. The section then gradually decreases until it reaches the top.

Increasing the Height

Sometimes a small tubular mast is placed right on the top to increase the height. At Breslau a large circular ring 30 ft. in diameter provides a little top capacity which is said to be equivalent to an extra 45 ft. of height. Hilversum also has an anti-fading aerial of this type.

The expense is very large and unless the station normally covers a service area of several hundred miles radius, this form cannot really be considered justifiable.

The recent introduction of the Droitwich station with its increased power has brought within its range many listeners who were previously just outside the service radius. It is somewhat natural that a crop of complaints of fading has been received, and there have been tentative suggestions of a non-fading aerial for Droitwich.

A little consideration will show that this is quite out of the question, for if we need 650-odd feet for a 400-metre transmission, we should require a mast nearly 2,000 ft. high for 1,500 metres!

Even the undoubted existence of fading on Droitwich can hardly be deemed to justify such an enormous structure, even granted the ability of modern engineering to achieve such a stupendous pile.

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Between Ourselves

By BROADCATCHER

Puzzled Pigeons

WITH burning interest I read in my morning paper an account of experiments made at a broadcasting station in the south of France with carrier pigeons. Their baskets were brought, it appears, to the foot of a transmitting aerial mast and ere the first batch was released the plant got under way, though with but a small proportion of its possible kilowats. The birds were not in the least affected. Up they rose to a goodish height, flew round a time or two, and then set off at full speed for home sweet home.

The power in the aerial was gradually increased until it was noticed that, like Albert's lion, the birds didn't like it at all.

Finally when the last batch was set free, with the transmitter going all out, the birds were completely baffled. The homers did not know where home was; the carrier pigeons were utterly fogged by the carrier wave. They rose; they fluttered gallantly aloft.

Their perplexity was manifest, and to a pigeon they gave up the task as hopeless, returning to their travelling baskets.

Just Waves

There be those who say that the carrier pigeon depends on certain unknown waves emanating from its home for its ability to shape a straight course to the loft where it was born.

It may be so; I don't profess to know. It is, though, very certain that, however comprehensive may be the training given to carrier pigeons, geography is not one of the subjects of the curriculum. Nor can any pigeon, no matter to what height its first circling flight takes it, see from aloft the home, possibly a couple of hundred or more miles away, to which it is to return.

This photograph came from a Continental agency with the following caption: "An original Radio-receiver which has been built into the wall. The loudspeaker has the form of a head of a dead"

Carrier pigeons have some mysterious means of direction-finding. So have the youngest swifts, who set out for Africa long after their parents have departed. It may be that this is completely upset by certain ether radiations at short range.

Aerial Visitors

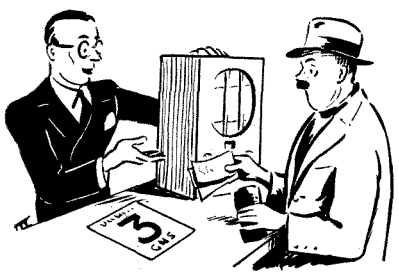
This somehow brings to mind the queer old days when the short-wave set was in its infancy. It was said—and with some justice—that when you were tuning one of these cranky things you had but to raise your eyebrows whilst in the act of receiving KDKA in order to change over to WXAF. If you next crossed your knees it was more than likely that WXAF would give place to PCJ.

These quaint old short-wave sets were the most amazing things ever. If your aerial lead-in wasn't quite taut but swayed a little before the winds of heaven it was quite on the cards that you might find yourself changing with bewildering rapidity from this short-wave station to that and back again as it swayed now towards and now away from the walls of your abode.

One friend of mine, who may or may not be a radio-liar, swears that in those days he was sorely troubled by the strange phenomenon, though he had tightened his lead-in so that it could not sway and had fitted all his controls.

with yard-long extension handles to avoid body capacity, he yet found that a station, tuned in after enormous trouble, would suddenly disappear, perhaps, to let another quite unexpected transmission reign in its stead.

He eventually traced the trouble,



" Wireless pigeons still with us "

so he assures me, to the propensity of his neighbours' fantails—all, he declares, positively charged—for alighting on his aerial wire in order to indulge in orgies of billing and cooing.

Pigeons Still With Us

You may think that that avian tale requires the proverbial pinch of salt. I merely relate it as it was told to me. I know that he took to sprinkling the pigeons' tails, using a catapult for the purpose, with something a good deal more solid than pinches of salt.

Wireless pigeons are still with us; but to-day they are human pigeons—two-legged birds as the old lady put it. They don't sit on aerials, but frequent cheap-jack shops where they offer themselves for the plucking by vendors of something-for-nothing wireless sets and components.

Queer Trait

It's a queer trait in human nature that there are many folk who still believe, despite a heap of nasty shocks, that there are philanthropists abroad in the business world, yearning to give away half-a-crown's worth of wireless goods in return for every sixpence spent.

The pigeon finds it very hard to recognise the hawk; but the hawk is ever hovering overhead, waiting for those who cannot believe that the best is usually the cheapest in the long run, whilst the cheapest is apt to prove itself actually by far the dearest.

The Eiffel Tower Reforms

For well over a year now the Eiffel Tower transmitter has been the bad boy of Europe, making itself a thorough nuisance on the long waves. Like most bad boys it has kept on promising to be good but has gone on being just as bad as ever.

I don't know how often the French Ministry of Posts and Telegraphs has announced that the station would cease immediately to broadcast on the long waves. When the first statement of the kind was made, just before the Lucerne Plan came into force, everybody cheered.

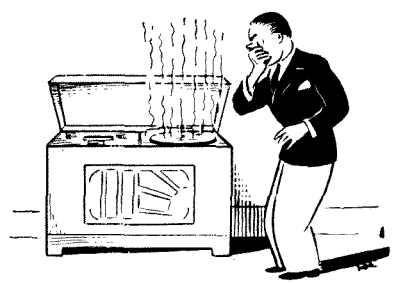
But Motala and Warsaw continued to suffer from FL'S interference just as before. The second announcement made us smile; by the time the fifth or sixth was made we had acquired the Gallic habit of shrugging our shoulders and waving hands of helplessness.

But now, at long last, Eiffel Tower has transferred itself to 206 metres, ousting Fécamp, which has gone up to 269.5. But Eiffel Tower is not to remain just an insignificant medium-wave station; it is to be the home of the high-definition television transmitter that will shortly be installed to serve the Paris area.

As the Tower is 985 feet high, it should have a splendid range on the ultra-shorts.

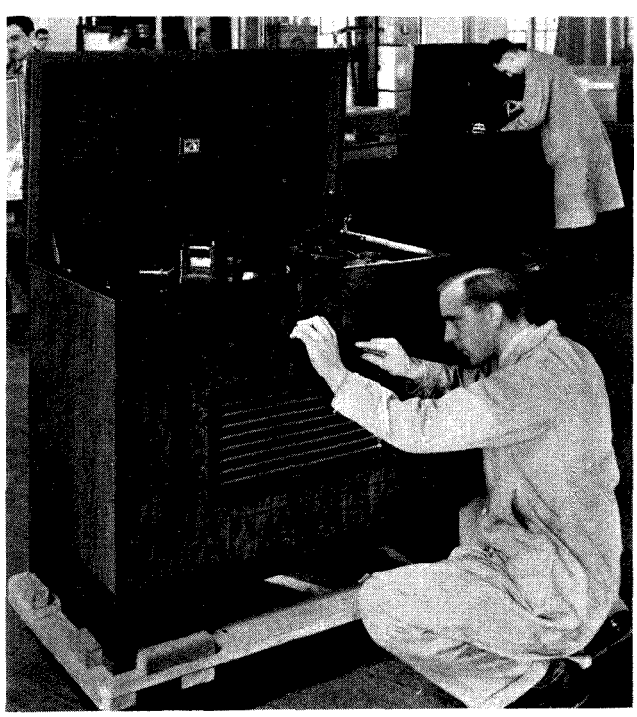
An Old Friend

I am glad that the Eiffel Tower is not to go out of wireless business but continue as a television station. It was, as readers probably know, the very first station in Europe to



" Tele-smelling "

send out regular entertainment programmes. It worked in the funny old days soon after the War on wavelengths ranging between 2,600 and 2,800 metres. That being so, every wireless set had to have coils that would tune up to 3,000 metres.



The H.M.V. factories are busy preparing a 15-valve auto-radiogram which will be fitted into the King's House—the gift to His Majesty from the Royal Warrant Holders

Tele-smelling

One of the best leg-pulls for many a year was that perpetuated recently by the Deutschlandsender, or Zeesen as I prefer to call it. The official German programme paper published an article, apparently written in all seriousness, which announced to an astonished world details of a marvellous new process of recording and of transmission.

In a word, owing to the discovery and use of odoriferous wavelengths, it had become possible to record perfumes, odours, smells and stinks on gramophone records. Photographs of " smell records " accompanied the article and it was stated that between cer-

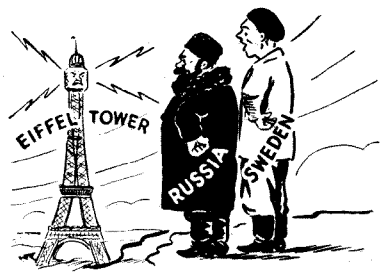
tain hours on a certain day the broadcast programmes would be accompanied by transmissions of appropriate odours. Listeners-in were invited to become smellers-in.

"Place your nose close to the loudspeaker," directed the author of the article, "and try to detect the scents. Brief reports from each circle of listeners will be much appreciated."

The Germans being an orderly people, trained to raise the right hand smartly and then to get on with it instanter, thousands obeyed the instructions and duly put their Nordic noses as far within the loudspeaker's spout as was possible. Many sent in reports of the reception of delicious savours, such as the perfume of frying sausages, that of wild violets and that of frothing Lager beer.

The power of suggestion is terrific; but there was one suggestion that in many cases passed unnoticed and this was that the date selected was the glorious "first of April."

Ten years ago the International Broadcasting Union was formed to control the wavelengths of all European broadcasters. Here is the secretary, Arthur Burrows—Uncle Arthur to a great number of British listeners—in his office at Geneva



"Eiffel Tower down to 206 metres."

A Swedish Giant

Probably you have heard Motala, the Swedish long-wave station, trying out its new plant outside broadcasting hours during the last few weeks. By the time these notes appear in print it is not unlikely that the new 150-kilowatt transmitter will have taken over the full programme service and that the old 30-kilowatt station will have closed down.

Now that the Eiffel Tower has kindly ceased to play the dog-in-the-manger, Motala's big transmitter will have a proper chance of showing what it can do.

From what I have heard of the experimental transmissions it is going to be one of the most useful of the long-wave stations for it comes in with a splendid strength and the quality is remarkably good.

All long-distance men, and today there is hardly anybody who does not indulge at times in the reception of far-away stations, will be delighted to have another fine transmission on the long waves.

The great point about such transmissions is that they are not nearly so much affected by conditions of daylight and darkness as those on the medium band.

It's good, too, to think that we shall be able once more to tune in the excellent Swedish programmes when we want them. Just before Motala's power was increased they had become none too easy to receive, for Stockholm, despite its 55 kilowatts, has been rather uncertain for some little time.

Not Good Enough

Manufacturers of wireless sets and components must sometimes pray to be saved from their friends. No reliable maker indulges in preposterous claims on behalf of his wares, but enthusiastic writers in the lay papers have a way of discovering in the course of their "tests" good qualities which no radio device could possess in this world.

Only the other day I came across a report in which my astonished eyes read: "Superhets used to be stigmatized for poor daylight reception. This XYZ (superhet) *does just as well in daylight as at night.*" (My italics.)

There is a queer thing, of which the writer of that report may not have heard, called the Heaviside Layer, upon condition of which the reception of stations at great distances depends. In daylight it does not help us much; after dark it is the best of friends. Therefore, no set, even if it contained 50 valves, could do just as well in the daytime as after sunset.

Again, we have all seen it stated that during tests certain car-radio sets were found to bring in every worth-while station in Europe, or something of that kind. It is not mentioned that the tests were made after dark, though the average motorist does most of his driving by day.

DIFFICULTIES ABROAD

IF any reader doubts the genuineness of the following extract from a letter we have received from abroad, we shall be very pleased to show him the original at this office.

"I profit to let you know that the most annoying effects we down here are fighting against, when we would like to hear a foreign, we mean european programe, is of course the fading assentuated variable intensities of coming and going, but worst are the avalange of statics parasitiscs, drag in by the tune in wave, which spoils completely any audition, which is a nerve irritant desgreableness."

Keeping H.F. Where

We take pleasure in presenting a special contribution by Marcus G. Scroggie, B.Sc., A.M.I.E.E. Mr. Scroggie has written frequently for "Wireless Magazine" in the past and is well known to readers for his knack of presenting rather difficult technical subjects in a readable fashion. Here he deals with the important problem of keeping high-frequency currents to their own part of the set and shows various ways and means of doing it

ONE of the prime objects of any receiver is to give a hearty and encouraging welcome to the tiny high-frequency (H.F.) currents produced in the aerial by the distant broadcasting station. Every effort is made, by low-loss tuning circuits and H.F. amplifiers, to nourish and cherish these tender growths until they are strong and vigorous enough to be operated on by the detector and converted into low-frequency (L.F.) currents ready to be further amplified up to loud-speaker strength.

If there is insufficient H.F. amplification the detector mutilates and distorts the programme in the

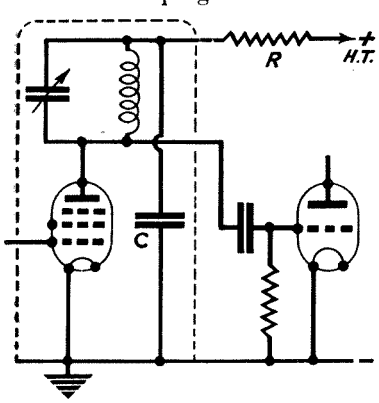


Fig. 1.—One way of preventing H.F. currents from straying; the condenser C provides an easy path, which can be screened if necessary, while the resistor R discourages paths common to other circuits

course of its duty: on the other hand, it is difficult to provide a very enormous amount of H.F. amplification; so some further amplification is needed in the L.F. department.

That, rather roughly, is an outline of what a receiver does. Perhaps the statement above that will give most offence to highbrow technical people is the description of the detector "converting" the H.F. into L.F. It suggests that when the pigs are put in at one end of the machine one gets nothing but sausages out, without even so much as a grunt left over. That is not quite so.

Without going into a full account of how a detector actually does work (which would leave no room to discuss anything else) it is sufficient to grasp that the output of any detector consists of a mixture of H.F. and L.F., and that there is generally a good deal more H.F. than L.F.

If nothing is done about it, this H.F. will be amplified still further along with the L.F., and find its way as far as the loud-speaker. As the loud-speaker pays no attention whatever to H.F. currents, you may ask why one need worry about such a state of affairs. There are several reasons; and failing to appreciate them is responsible for quite a large proportion of the troubles—major and minor—of which set-builders complain.

It is therefore necessary for the smile of welcome given by the H.F. stages to be changed to a frown directly the detector has been passed, and for H.F. currents to be confined strictly to their own quarters.

One of the reasons for doing this is that any amplified H.F. currents that may be circulating in the L.F. and loud-speaker circuits are practically certain to work their way back to the aerial, and from there to be further amplified, causing amplification without definite limit—in other words, instability, oscillation; call it what you will.

While the H.F. circuits are generally screened with considerable care to prevent this from happening, no such precautions are adopted for the L.F. parts; and so there is really nothing to stop instability if these are handling H.F. currents of considerable strength.

An interesting case was that of a receiver in which steps had been taken to keep H.F. currents out, and these were successful in preventing noticeable bad effects in normal circumstances. Directly an electrostatic loud-speaker was used (which has a very large metal surface connected to the anode of the power valve) the receiver became unstable, owing to the slight residue of H.F. being radiated extensively from the loud-speaker and picked up by the aerial. Incidentally, this took place only on long waves; for reasons to be given shortly.

Bad Effect

Another bad effect of stray H.F. currents is that they hinder the low-frequency valves in the execution of their duty. If a lot of overgrown H.F. gate-crashers are forcing their way in, there is just so much less room left for the authorised L.F. guests; in fact, the latter are bound to be roughly handled and deprived of their handsomest features in the struggle if they attempt to pass through in full force.

To express the matter less fancifully; if a valve is able to handle a certain amount of L.F. power without distortion, the added presence of a large amount of H.F. power is

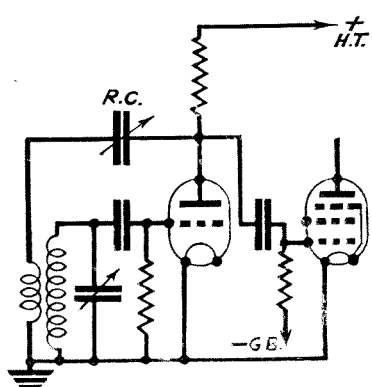


Fig 2:—In this simple reaction circuit the H.F. currents not needed for reaction are passed on to the next valve and distributed all over the set, to its grave detriment

It Belongs

By
MARCUS G. SCROGGIE
B.Sc., A.M.I.E.E.

bound to cause serious overloading and distortion. This is, in fact, the reason why a detector valve is so liable to be overloaded, even when it is handling quite a moderate L.F. output; and was the motive of the trend towards "power grid detection" some time ago, when it was recognised that the presence of a much larger H.F. accompaniment has to be allowed for.

Considering Methods

Having now clearly seen the importance of keeping the H.F. currents within their allotted territory, we can proceed to consider the methods of doing it. The currents in the H.F. amplifier circuits are confined to their own places by providing easy and pleasant paths for them, via by-pass condensers; and difficult paths leading away to batteries or power unit, by the insertion of resistors or chokes. This is known as H.F. decoupling (L.F. decoupling has nothing to do with our present problem), and Fig. 1 shows a typical example of this applied to a H.F. amplifier.

The condenser C allows the H.F. part of the valve current to flow back easily to earth without having to go outside the dotted precincts; while the resistor R discourages any attempt to stray abroad into the circuits that are common to the other valves.

But just now we are concerned more particularly with stopping the way of escape via the direct line of valves. If the popular grid-leak type of detector is used, the detection process occurs between cathode (filament) and grid, and the rest of the valve acts as an amplifier of the mixture of L.F. and H.F. There is therefore plenty of H.F. issuing from the anode; and very often this is put to good use for reaction purposes by feeding a proportion of it back to strengthen the H.F. amplifier currents.

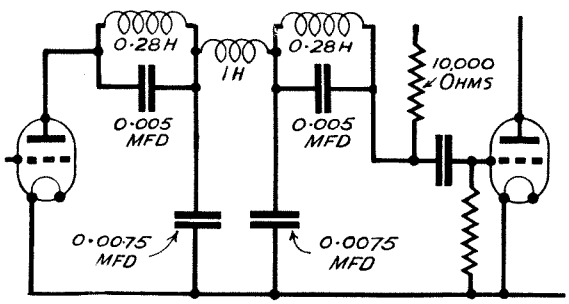


Fig. 4.—An example of a special filter for giving a sharp cut-off. Its top frequency is 3,500 cycles per second

This has the effect of side-tracking at least part of the unwanted energy. But "Satan has some mischief still for idle hands to do," we were told as children, and is very true of H.F. discharged, like an "old lag," from the detector, and unable to find a job in a reaction coil. In the plain condenser type of reaction circuit (Fig. 2) there is nothing for it to do when reaction is at zero. It therefore passes on to the next valve and causes trouble.

This disadvantage is partially overcome by using a differential reaction condenser (Fig. 3) in which there is always a fairly constant capacity path to earth.

If no reaction is adopted, a plain by-pass condenser is connected from detector anode to earth. To be effective this condenser path should have an impedance that is very low compared with that of the valve. Suppose the detector valve has an impedance of 12,000 ohms. The condenser should be not more than about 1,000, even if only partial by-passing is expected. The impedance is highest at the longest wavelength, or lowest frequency; so we shall assume 2,000 metres (150 kilocycles), and the capacity required is therefore about .001 microfarad.

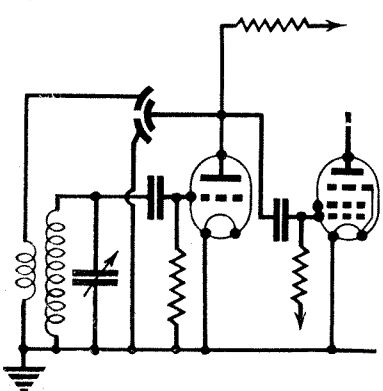


Fig. 3.—A differential reaction condenser provides a return path for H.F. currents at all adjustments

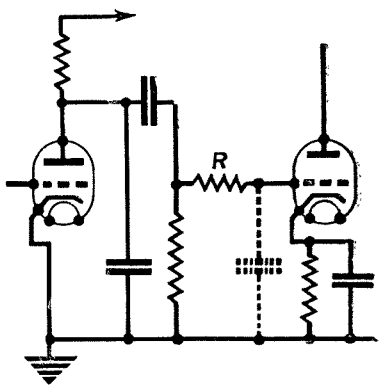


Fig. 5.—A very simple H.F. stopping device—a grid-leak type of resistor in series with the grids of low-frequency valves

Criticisms

There are several criticisms that can be aimed at this selection (though actually it is about the best that can be made). The first is that if the detector valve has a mutual conductance of at least 1 milliampere per volt—and even battery valves are now well above that standard—there is no suppression of H.F. at 2,000 metres. All that has been done is to keep it from being actually increased by the valve.

Impracticable Good Quality

Of course, the position is rather better at the shorter wavelengths, when the impedance of the condenser is less. But in a super-het the *frequency* is less—usually about 110 kilocycles—and as the condenser then has a higher impedance the suppression of H.F. is even less effective. That is why this problem is acutest in super-hets, and why it is worse on long waves than on short.

Then although ·001-microfarad

is on the small side to be really effective in by-passing H.F., it is quite large enough to have an appreciable bad effect on L.F. It is desirable, for really good quality reproduction, to obtain audible frequencies unimpaired up to at least 10,000 cycles per second. Unless one is under the shadow of a broadcast station, however, interference makes that impracticable.

Taking a limit more in keeping with conditions as we find them—6,000 cycles per second—the impedance of the condenser is 26,500 ohms. That is effectively in parallel with the intervalve coupling—resistance or transformer.

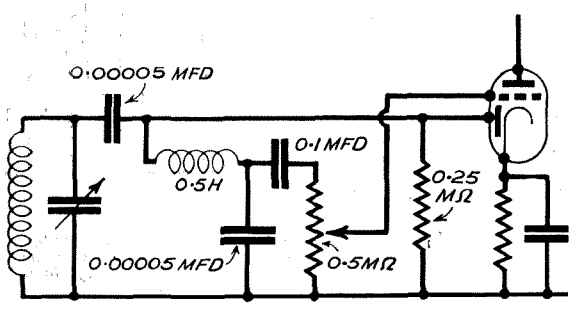


Fig. 7.—The modern method of using diode detectors enables a H.F. filter to be inserted between them and the low-frequency amplifier, thus preventing overloading of the latter

High Coupling Resistance

If, for example, there is a resistance of 50,000 ohms, it is quite seriously affected by the condenser: the amplification falls off at the high notes; and reproduction is less true than it should be, because the higher harmonics are weakened. If the coupling resistance is higher still, the effect is more pronounced. That is why a high coupling resistance is not good when quality is of more importance than amplification.

Progressive Effect

The trouble is that a condenser by-pass comes into effect gradually as the frequency is raised, and if it is large enough to be even moderately effective at high frequencies it is beginning to cut down the upper audible frequencies, too. They have already been cut down a good deal, if the H.F. tuning is very sharply selective, as in a super-het; so any further tendency in this direction is not very welcome.

The difficulty is acute when really high quality is wanted; of course, if boomy or lifeless reproduction can be tolerated then all that is needed is a good big by-pass condenser. But what the best people want is a more sudden cut-off, so that the lowest H.F.—say 100 kilocycles per second—is very completely extinguished, while the highest L.F.—say 10 kilocycles per second—is completely preserved.

The proper way to do this is by means of a correctly-designed and applied filter.

Unfortunately any particular filter is correct only for one coupling system: if the connections or resistances are different the filter is more or less wrong. Unless things are *very* different from the standard arrangement, a filter gives results very much better than a plain by-pass condenser; and there are several types now on the market. Some of these have a sharp cut-off at some comparatively low frequency—5,000 or even 3,500 cycles per second—with a view to cutting out whistles, gramophone scratch, and other sorts of noise. The less of this sort of elimination that is necessary the better. Fig. 4 shows a filter giving a cut-off at 3,500 cycles.

Another and simpler device sometimes used to stabilise a receiver that suffers from trespassing H.F. is a grid-leak of about a megohm in series with one or more of the L.F. valve grids (Fig. 5). At first sight it may be difficult to see how this works, for a L.F. valve is always (except in Class B) biased so that no current flows in the grid circuit.

A Tiny Condenser

But one must not forget that the grid is a tiny condenser (indicated by the dotted line) and forms a sort of potentiometer with the grid-leak, so that at high frequencies most of the signal is lost in the leak.

This system is no better than the plain by-pass condenser so far as sharpness of cut-off is concerned; and it has at least one disadvantage all its own. Not only is it out of the question for class B valves, but it is also rather bad policy to have such a high resistance in series with the grid of a power valve—pentode or triode—particularly the more modern types with high conductances. If there *is* a trace of reverse grid current, it causes part of the bias voltage to be lost with the result that the anode current goes up unpleasantly.

The only thing to recommend it is that if the H.F. stopping is distributed between several mild doses the cut-off is more steep than that due to a single drastic one. It is therefore sometimes a useful auxiliary to a moderate-sized by-pass condenser.

Fig. 6 shows a comparison between one big dose and three smaller ones. Curve 2, relating to three stages of

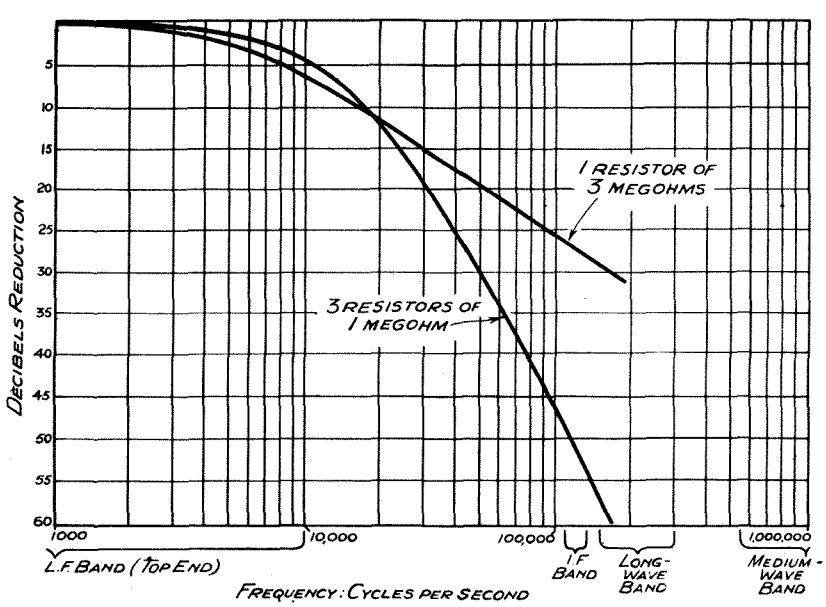


Fig. 6.—When the method of Fig. 5 can be applied to more than one valve it is better to do so. This curve shows that three mild doses are better than one strong one

mild reduction, is much more effective in cutting out H.F. of 100 kilocycles, and yet causes less loss of L.F. voltage.

An important point to consider when a by-pass condenser is relied upon is that while the L.F. currents produced in the valve are obliged to pass through the high impedance of the intervalve coupling and are therefore kept quite small, the condenser forms almost a short-circuit for H.F. currents which are consequently large.

Easily Overloaded Detector

Remember, too, that they would be larger even if the impedance were the same for all frequencies. That is why it is so easy to overload a detector valve. This difficulty is the penalty for trying to do two things—detection and amplification—in one valve. There is no opportunity for removing the H.F. *before* the amplification is carried out.

Special Announcement
An important series of articles by Dr. N. W. Maclachlan, one of the foremost authorities on loudspeakers, will begin in our next issue.

The modern combination valves—double-diode-triodes, and others—are the solution of this difficulty. Previously it was necessary to use a separate additional diode valve in order to deal with the H.F. at the correct moment. Now the two processes can be separated within a single valve. It is practically impossible to overload the diode detector, and the triode portion can cope with a very much larger L.F. power if the H.F. has by that time been more or less eliminated.

Unusual Valves

Fig. 7 shows how a filter can be introduced between the diode and triode parts of the valve. You will notice that the values of the components are rather unusual: they have been chosen to give very high-quality reproduction and at the same time considerable elimination of H.F.

Most people use 100 micro-microfarad (.0001 microfarad) or even larger grid and by-pass condensers in place of the 50 micro-microfarads, and larger resistors than .1 megohm, but there is then some loss of high notes. This is a simple circuit; one can do all sorts of stunts using the second diode. But that is another story.

Apparatus As It Might Be Tested

Suggested by a French Contemporary

HEAVENS above, they've done it again! One would really think, wouldn't one, that the Wishbone Company had reached the zenith of their achievement. But no, here they are with their latest model smaller than anything before but larger in price.

Why this largesse? (Do we really mean that? We don't know—anyhow, you will understand.) Because the coil is wound with silver wire and the diaphragm is gold embroidered. What taste! What joyous execution! This speaker must be seen by every amateur—every professional—indeed, every user.

Details of price and performance can be obtained from the manufacturers . . .

What about your gramophone disc? Do you play your own or are you content to listen with bovine stolidity to the discs sent you through other men's efforts? You should experience for yourself the joy of reproducing your own gramophone discs.

Quintessence of Luxury

To make this a little more easy the Holdhard Co. have just introduced their new motor. And what a motor. There are no wheels in this motor. Neither is there an accelerator, brake or any other unnecessary adjustment. The motor is the quintessence of luxury.

Tuned by sympathetic vibration it starts as soon as the disc is placed on the turntable, and it stops from sheer exhaustion at the end of the record—unless it happens to be a very hot jazz, in which case it may reverse and play the record through backwards.

Do you not think that human ingenuity has excelled itself here?

How good is the thrill that warms the cockles of one's heart at the introduction of a new Blue-bottle valve. The latest masterpiece from this renowned hive of industry is a miracle of simplicity.

Inside the gleaming bulb shimmering in the soft radiance of light we perceive—what do we perceive? Would you believe it, there are just two electrodes. How inconceivably exquisite!

"Inverted" Valve

The discerning reader will, of course, at once appreciate the unique possibilities of this arrangement. The valve, of course, can be used with the top electrode on top or the bottom electrode on top in which latter case the makers say that the valve is inverted. Is it not clever?

How we all hope that the Blue Bottle Co. will make some more valves like this.

Ah, but wait! You have not yet heard of our star introduction this month. It is a set! Believing, as we do, in a stern simplicity of language we need say little more than that.

It is of the type known as midget, and it measures 6 in. by 3 in. by 14 in. high. Yet in this tiny space are located no less than eleven valves. There is also a loud-speaker and some works.

Booful Pocket Receiver

Restrain your enthusiasm, gentle reader. We assure you it is true. How they got them in we do not know, but if you want to see more of it you must go to your dealer and ask him for the Booful 11-Valve Pocket receiver. No doubt he will not have one in stock, but you should be able to see one before the end of the year.

The price is high, but then think of having eleven valves in a space less than they would occupy in their own little cartons. Is it not a masterpiece?

J. H. R.

Radio News from Abroad

Dutch Station for Brazil : : Brno Interval Signal : : Lahti's 220 Kilowatts : : Language Record : : British Airport Transmitters : : Free "Mike" Publicity

By JAY COOTE

BRAZIL

DUTCH radio firms have been entrusted with the building of a 50-kilowatt station for Rio de Janeiro; it is to be shipped shortly and its installation should be complete before the end of the summer. Although no channel has been definitely fixed, the new station is expected to work on or about 270 metres.

BULGARIA

So far, Bulgarian listeners have had to be satisfied with broadcasts from the little Radio Rodno station, the power of which is too low to do more than cover the capital and surrounding localities. The Government has now placed an order with a German firm for the supply and installation of a 100-kilowatt transmitter, which may be brought into operation towards the end of next year.

CZECHOSLOVAKIA

Most European stations during recent years have replaced metronome or morse interval signals by musical boxes or similar sound-producing instruments. Brno, after trying for some time to find a distinctive signal, has reverted to the more primitive morse alphabet. Between items in the programme from its own studio, it now transmits BRNO (— . . . . — . — . — — —).

FINLAND

Two small Finnish relays have been working on 400.5 metres, between the channels used by Marseilles PTT and Munich. At least one of these, namely, Sortavala, will be heard in the future as it is to be provided this year with a 20-kilowatt transmitter, when it will broadcast on an exclusive channel.

The 220-kilowatt station which Lahti will shortly possess will be the second largest in Europe.

GERMANY

With the exception of Moscow, Stuttgart holds the European-station record for the number of languages used in announcements. In the nightly broadcast (B.S.T. 00.00-02.00) the announcer can be heard giving out the details of the programme in German, English, Spanish, Italian, French, and Polish. Continental stations, in particular the Germans and Russians, realise that their transmissions are heard almost throughout Europe.

GREAT BRITAIN

With the constant increase in civil air traffic, a number of special transmitters have been installed at aerodromes in Great Britain and Northern Ireland. In addition to GED, Croydon Airport, it is possible to pick up on 862 metres (348 kilocycles) communications with aeroplanes from GFT, Newtownards (Belfast); GEB2, Hedon (Hull); GEM, Manchester; GEN, Portsmouth; and GER, Abbotsinch.

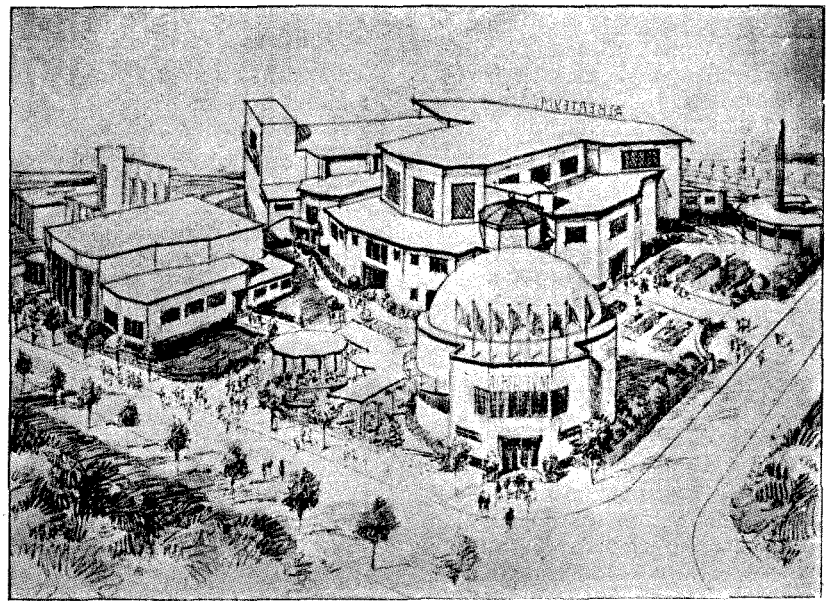
An extra channel has now been borrowed from the aircraft beacon band, namely, 826 metres. This will be used mainly for Continental traffic, leaving the 862-metre wavelength for operating with home airplanes.

NORWAY

Although, according to the Lucerne Plan, Norway was only entitled to one long-wave channel allotted to Oslo, in order that the transmissions of the temporary 100-watt Tromso station may cover a wider area, the latter is now using 1,186 metres (250 kilocycles), the original wavelength given to the capital.

ROUMANIA

If you desire free microphone publicity all you need do is to be a radio pirate in Roumania. At regular periods the Bucharest studio broadcasts the names and addresses of owners of wireless sets who, following an official application, have failed to renew their licences. It is reported that in every instance the results are successful and that an early visit the following morning is made to the local post office.

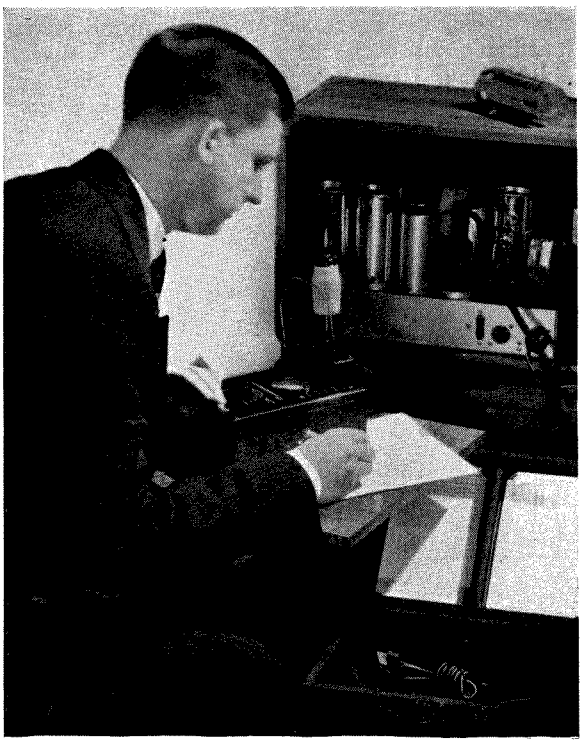


Brussels is holding an International Exhibition this year in which radio will take a prominent part. Here is an artist's impression of the huge hall devoted to science and radio

Hints for the Service Engineer

By G. P. KENDALL, B.Sc.

This special "W.M." feature is primarily intended to assist the radio service engineer. As so many interesting points are dealt with every keen radio fan who makes his own "running repairs" will find some subject or hint of interest to him. The author, who is known to you as a practical man, will be pleased to discuss questions sent to him



A service engineer using the Weston Analyzer to investigate the working conditions of a screen-grid valve. The instrument enables all the essential voltages and currents to be read off in a few seconds

TWO recent experiences of mine with metallised valves seem worth recounting, for although the faults involved were probably rare ones they certainly form a cunningly concealed pitfall into which anyone might tumble unless warned.

In the first case the set was a four with two high-frequency stages, pentode output, and A.V.C. On the medium waveband it behaved fairly well, although it did not seem quite so stable as I expected, but on long waves it was definitely all adrift; reaction was uncontrollable with tremendous overlap and much squawking and grunting, and there were most remarkable hand-capacity effects in the neighbourhood of the detector valve.

Investigation

I must admit that I spent quite a long time over this set. It was new, and had never worked correctly, so that the trouble might well have been due to some error of design, and hence it was necessary to investigate quite a number of matters which might otherwise have been taken for granted.

Eventually I found the fault by accident—quite a painful one at that! I was observing for the *n*th time what extraordinary things happened when the hand was placed near the detector valve, when I chanced to touch the metallising of the bulb and received "quite a nasty little packet." That seemed too strange to be true, but a voltmeter confirmed that there was a matter of 200 volts between the metallising and earth!

Further investigation then showed that the metallising of this valve was connected direct to the anode instead of to cathode; there was the mystery explained. Probably the fault is a very unusual one, but, curiously enough, I encountered something not unlike it within a few weeks of the first example.

NEXT MONTH

In our next issue we shall present details of a simple and inexpensive, but efficient, audio-frequency oscillator specially designed for this section by Paul D. Tyers. Easy to build and to adjust, it should prove invaluable not only to the service engineer but to the serious amateur also

In this second case the receiver had operated normally for a year or more, and then suddenly became extremely unstable. It oscillated violently over nearly half the dial on long waves and gently over about a quarter of the medium range. It was not very thoroughly screened, but such screening as there was all showed good contact to earth, all valve voltages and currents were normal, and all by-pass condensers showed capacity.

Substituting spare valves one by one presently cleared the fault, and then it was found that the metallising of one of the screened grids had become disconnected from its filament, apparently inside the cap, since no defect could be seen. Upon fitting an external connection the valve became usable once more.

Evidently the design of the receiver was such that stability depended upon the screen-grid valves being well screened, and to do this effectively the metallising must be properly earthed; a screen which is floating may on occasion be worse than no screen at all.

Measuring Output Voltages

It is sometimes desired to know the actual output voltages given by a receiver under test conditions,

although merely comparative figures are as a rule sufficient. To obtain results that can be expressed in terms of actual voltage is usually considered to be a task for a relatively expensive piece of apparatus, but for work of moderate accuracy a very crude form of backed-off valve voltmeter will serve. Such a "gadget" can be fitted up in most cases at quite small cost.

One requires a low-reading milliammeter, a similar voltmeter, a valve, batteries, and some miscellaneous bits and pieces arranged as shown in Fig. 1. Here the valve is set up to act as a bottom-bend rectifier, with grid condenser and leak arrangements to exclude D.C. potentials.

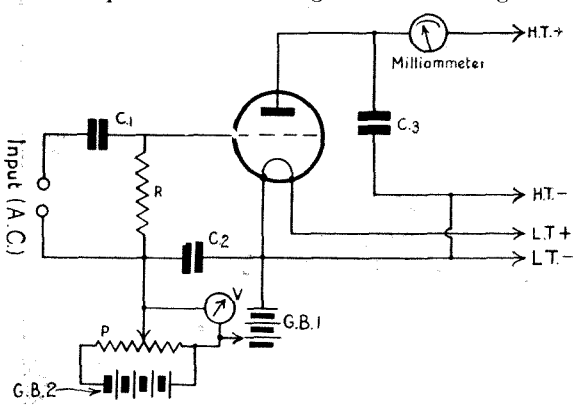


Fig. 1.—This simple circuit for output voltage measurement is in effect a valve voltmeter of the "slide-back" type

The operation of the circuit is as follows: The valve is adjusted roughly to its bottom bend by means of the battery G.B.1, and the reading of the milliammeter is noted. The signal voltage input is then applied, whereupon the anode current will show an increase.

Next, additional bias is applied by turning the potentiometer P round from its zero volts setting (where it was placed for the previous adjustment) until the anode current comes down to its previous figure again. The additional grid-bias voltage is then read on the voltmeter V and this is equal to the peak voltage of the A.C. input—a figure which can be used for all comparative purposes.

Suitable Size

For most work it suffices to be able to measure up to about 10 volts, and to do this one must use a voltmeter reading not less than 0-10, together with a battery of equivalent voltage for G.B.2 (a 9½-volt grid-bias unit will usually serve).

Under these conditions P should have a value of 5,000 ohms, assuming that the voltmeter is of reasonably high resistance. If it is known to be of low resistance then the potentiometer must be of some 1,000 ohms only, with consequent heavy drain on G.B.2.

A low resistance meter does not introduce errors in either case, but merely makes it difficult to obtain accurate settings of P and may overload this latter.

The grid condenser C_1 may be of any fairly large capacity from .01 to .1 microfarad, C_2 can range from .1 to, say, 2 microfarads, and the same applies to C_3. The grid leak should be of about .5 megohm, while the valve is preferably of the HL or "Special detector" type: a triode, of course.

Should it be desired to measure voltages in excess of 10, the best procedure is usually to connect some sort of voltage-divider network of resistances across the source, and measure only a known fraction of the total voltage.

Thus, if it is desired to measure the output voltage of a receiver when it is delivering a considerable signal, one might connect, say, ten resistances of 400 ohms each in series with each other and across the output terminals; if the metering circuit is placed across only one of these resistances it will obviously be measuring only one-tenth of the total output voltage, and one can calculate accordingly.

Naturally, the total resistance value must be chosen to suit the particular case, and the resistances themselves must be of at least fair accuracy, although this is unimportant if purely comparative readings will suffice. Some sort of output load for the set is always necessary, of course, and the valve voltmeter will normally be connected across this.

Output Load

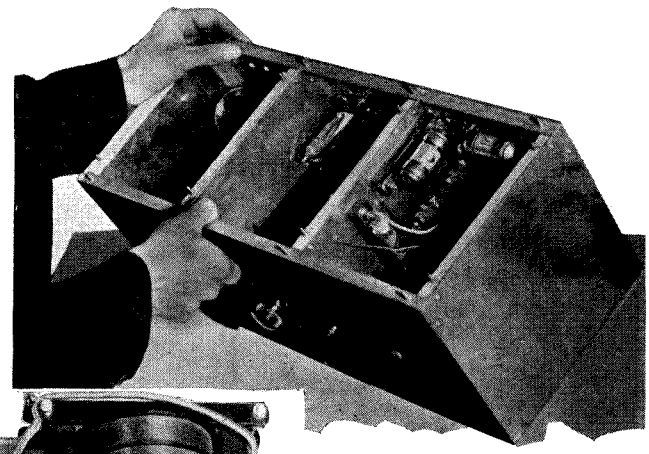
In many cases this load will take the form of the loudspeaker associated with the receiver, whereupon the meter circuit can be applied direct or via a multiplying network of fairly high resistances. If it is not desired to work into the loudspeaker then an equivalent resistance load should be provided, and this can be combined with the multiplying system if desired.

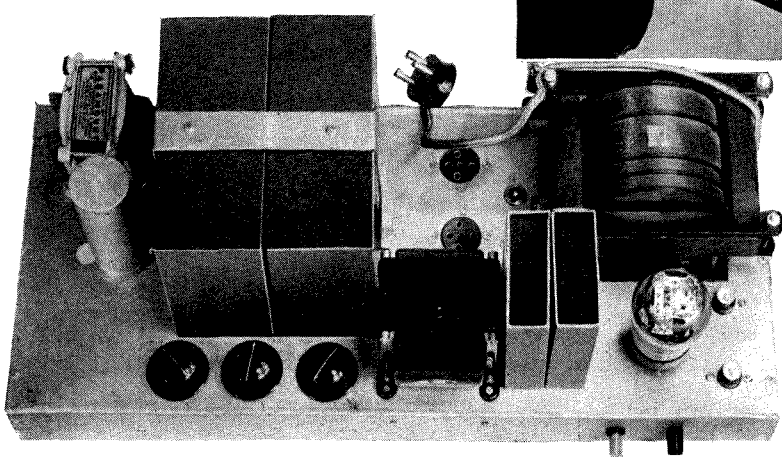
Total Resistance

In the latter circumstances the total resistance of the network should be of some 3,000 to 5,000 ohms for a triode output valve, or 5,000 to 10,000 for a pentode. It is not as a rule necessary to provide the optimum figure in any given case, but it can readily be obtained from the valve maker's data sheets should it be desired.

A useful card of little gadgets and accessories intended to facilitate testing work. It is supplied by the Automatic Coil Winder Co. and the price is half a crown

Last month, P. Wilson dealt with the technical side of his own power amplifier. Here he continues his technical description, dealing particularly with the mains-supply unit, and gives some useful hints in the construction. New readers who intend to build this powerful high-quality amplifier are advised to read Mr. Wilson's preliminary description on pages 282 to 286 in our last issue





Designed by
P. WILSON,
M.A.

An Enthusiast's Power Amplifier

FIRST of all, I must apologise for a small discrepancy between the circuit diagram as published last month and the pictures. I had forgotten when I drew the diagram that in this version of the amplifier I had split the 40,000-ohm resistance R_5 into two parts, each of 20,000. The reason was a simple one : I had run out of 40,000-ohm resistances, but I had a stock of 20,000's !

Safety Precaution

In this month's circuit diagram the two resistances are shown so as to agree with the wiring diagram; but, of course, a single 40,000 serves just as well.

Another small correction. Do *not* omit the resistance R_{16} even if the condenser C_{13} is an electrolytic one. My brother had a very nasty jar a fortnight or so ago from a commercial receiver in which the manufacturers had relied on the leakage in the electrolytic condensers to discharge all condensers when the set was switched off. It didn't, and he got a packet sufficient to burn a hole in his hand !

Now let us look at the mains unit. It is a full-wave rectifier circuit of normal type with, however, one or two frills. The fuses F_3 and F_4 are inserted in the anode leads to save damaging the mains transformer, the rectifier valve or the smoothing condensers in case a short-circuit, or other fault which would have the effect of drawing off an excessive high-tension current, should occur in the mains unit or the amplifier.

I started to use this safety device as the result of one or two unfortunate experiences with former amplifiers, and the arrangement has cost me a few pence in flash-lamp bulbs and saved many a pound in components on several occasions since that time. I never grudge the bursting of a fuse : it is both a warning of and an insurance against trouble.

The switch S_1 and the mains fuses F_1 and F_2, by the way, are not mounted on the chassis. It is much more convenient to have them mounted directly in the cabinet.

Alternative Voltages

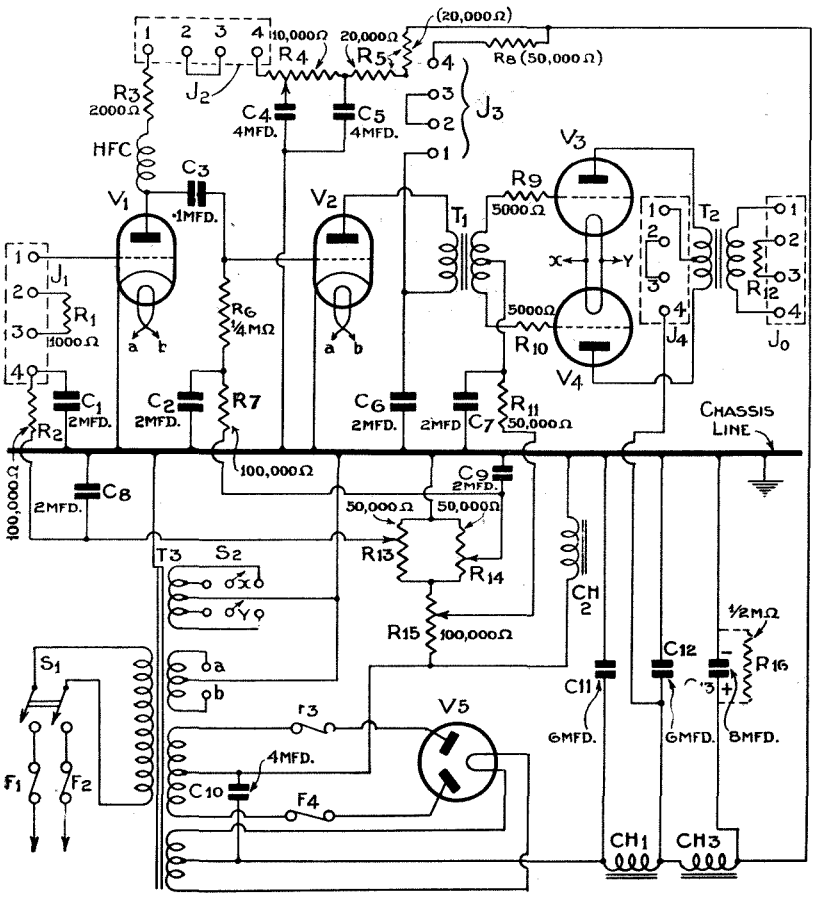
The D.P.D.T. switch S_2 switches the output valves to either the 4-volt or the 6-volt filament winding on the Varley mains transformer. I found this very useful, as I had a few LS6A valves in stock and I wanted to use them up before going over to the newer 4-volt output valves.

The choke CH_1 is of low inductance and is inserted to provide additional smoothing, besides the loudspeaker field CH_2, for the full rectifier output. It is connected in the positive high-tension lead, whereas CH_2 is in the negative lead, but that is of no consequence so far as keeping hum out of the loudspeaker field is concerned.

Curious Effect

An interesting point, however, does arise in this connection, and it is one that has apparently only been discovered (by Professor Terman) during the past year. (Proc. I.R.E., August, 1934.)

In an ordinary amplifier without a push-pull output stage a certain



The theoretical circuit of the amplifier. The arrangement, briefly, is one stage resistance-capacity coupled to a second stage, which is in turn transformer-coupled to two valves in push-pull. A valve rectifier is used for supplying high tension. Note that both letter references and actual values are given

amount of hum does get through, however liberal the smoothing, if the last choke-condenser filter before the amplifier is in the negative lead.

The explanation is to be seen in Fig. 7 from which it is clear that any stray capacity from the high-tension winding of the mains transformer to the earthed transformer frame by-passes the smoothing choke in the negative lead and causes a small ripple of hum-frequency to pass round the circuit: via earth, through the amplifier, and back to the rectifier valve through the high-tension positive line.

Preventing Hum

This ripple current has to pass through any choke in the positive H.T. line, and any such choke will be most effective in stopping the ripple if its associated filter condenser goes direct to earth and not to H.T.—

For this reason it is wise to put the last section of the filter (that is that section just before the amplifier) in the positive line.

Now originally I placed the choke CH_1 immediately after the rectifier, but although this clearly did not obey the rule I have just mentioned, I found no ripple to worry about. Why?

The answer is that the choke CH_3 satisfied the required condition so far as the earlier stages of the amplifier were concerned, and since the output stage was in push-pull any ripple there cancelled out. So I avoided the trouble by good luck rather than good intention.

In the circuit diagram shown I have connected CH_1 in the section of the filter after CH_2 in accordance with Professor Terman's recommendations, since in that case the suppression of hum does not depend so much on the exact matching of the push-pull valves.

The wiring diagrams are straightforward and the design is such that it is not at all necessary to follow the precise routes slavishly.

One or two points are perhaps worth noting. In the amplifier ordinary baseboard valve holders are used, but I have interposed a thin sheet of bakelite between the holders and the bottom of the metal box. This is a precaution I always take in such cases nowadays; I had an unfortunate accident once, owing to the snapping of the spring support in the sockets followed by a shorting of the high tension.

Insulate the Jacks!

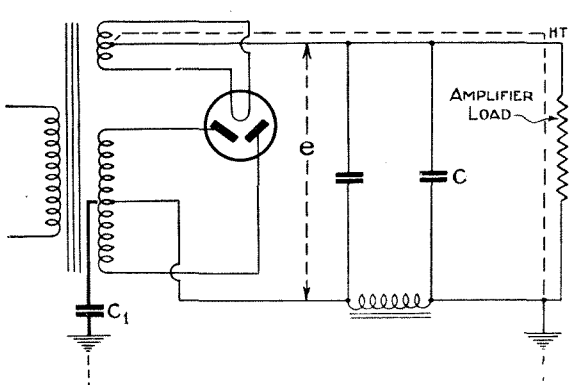
Do not forget to insulate the high-tension jacks from the box by means of ebonite washers and test the insulation to make sure there is no electrical continuity between the box and the frame of the jack.

The layout of the mains unit chassis has been so arranged that wherever possible the connections are underneath the chassis; in operation there are only two terminals above the chassis which are at a high voltage. In this particular case (the choke CH_1) I could not arrange the terminals below the chassis, but I did put them in such a position that contact with them would be very unlikely.

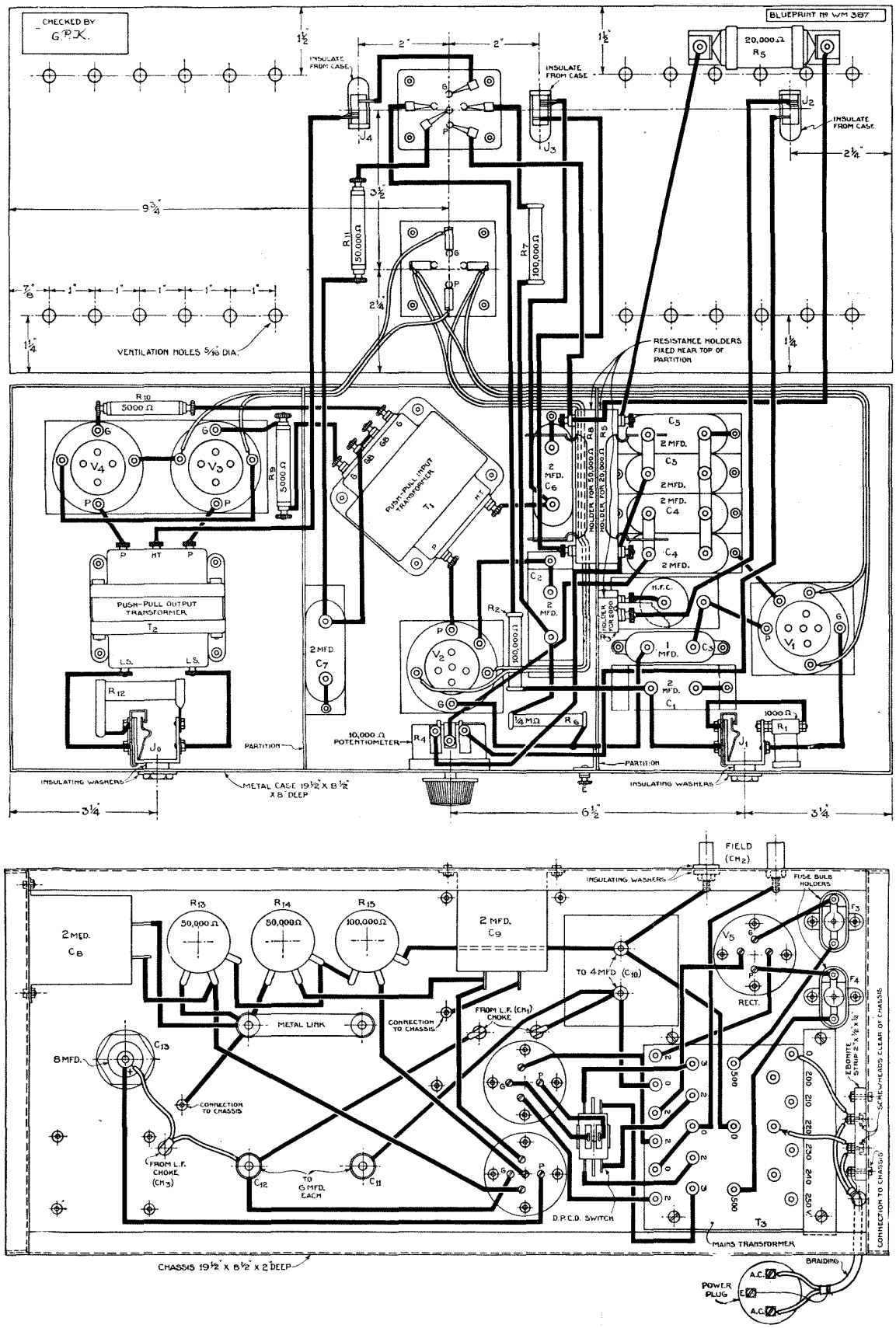
Constructional Points

The two (large) 6-microfarad condensers are held down to the chassis by a metal strap; the terminals go through ¾-in. holes in the chassis so there is plenty of clearance.

The 4-microfarad condenser C_{10} is



Showing how the capacity between the high-tension winding on the mains transformer and earth by-passes a choke in the negative lead. The path of the ripple current is shown dotted. If e is the ripple voltage in the rectifier output the hum voltage across the load is $e \times C_1/C$. This indicates the advantage of keeping C large



A full-size blueprint of the Enthusiast's Power Amplifier can be obtained for half-price—that is 9d., post paid—if the coupon to be found on the last page is used before June 29. Address your application to the "Wireless Magazine" Blueprint Department, George Newnes, Ltd., 8-11 Southampton Street, Strand, London, W.C.2. Ask for No. WM387.

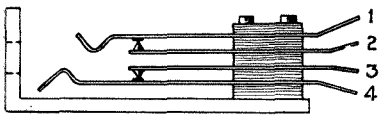
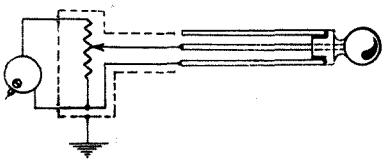


Diagram of a double-circuit jack, showing the key to the numbering in the circuit diagram and blueprint



The leads from the pick-up and volume control on the motor board should be effectively screened

made up of two Ferranti 2-microfarad condensers in parallel; a piece of ¼-in. ebonite was drilled to fit over the terminal posts so that by screwing up thin 5 B.A. nuts tight down on to this ebonite sheet the condensers were fixed to the chassis without straps or other special means of fixing.

Fuse Holders

The Bulgin fuse holders for F_3 and F_4 were chosen because with that particular design it was easy to reverse the terminals. By doing this the fuses could be inserted from the top of the chassis, but all the connections (which, it should be noted, are in the 500-volt A.C. line) are underneath the chassis. Another safety measure; having had a few 500-volt shocks in my time, I now take every precaution to avoid them!

By the way, make sure that the reversed terminal screws are countersunk in the bakelite holder sufficiently far to avoid any possibility of short circuit to the chassis.

In connecting up the 4-way lead between the amplifier and mains unit, use heavy gauge wire. The leads for the output valves have to carry over 4 amperes, so that it does not need much resistance in the leads to cause an appreciable voltage drop. The same point should be borne in mind when wiring the filament connections in the mains unit.

After the wiring is completed, make sure that the valve holders on the box and on the chassis, between which the 4-way and 5-way leads are connected, are wired up in the same sense, so that each valve will get its proper high and low tension and grid bias. Test the cables also to ensure that the plugs have been wired correctly.

Before switching on, see that the grid-bias potentiometers in the mains unit are set so as to *over-bias* the valves rather than under-bias them. For this the sliders should be set not more than quarter of the way round from maximum bias (i.e., from H.T.— end).

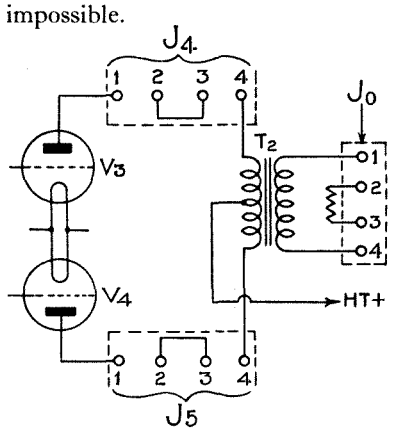
Adjust the output bias first so that the total anode current in the output stage is between 100 and 110 milliamperes. Then adjust the bias for V_1 and V_2 so that the anode current for each valve is 6 milliamperes.

After that it is well to check up the high-tension voltages on the valves, making sure that there is not more than 200 volts on V_1 and V_2. If you should find more than 400 volts on V_3 and V_4 the bias on those valves can be reduced slightly, but not so much as to make the anode current greater than the maker's rating for the valves.

After you are satisfied about the voltages, increasing or decreasing the values of R_5 and R_8 if necessary to bring the voltages of V_1 and V_2 within the required range, you may have to readjust the bias potentiometers so as to get the right current values again.

I mention these details of adjustment because one cannot be certain, even after building one or two amplifiers of the same type, precisely what resistance values will be required for another one.

There are usually some slight variations in mains transformers, mains voltages, valves, and resistances which make exact calculations impossible.



An alternative circuit for output stage, showing double-circuit jack in each anode lead for the purpose of checking the anode current of each valve, grid bias, etc.

LIST OF COMPONENTS FOR THE P. WILSON AMPLIFIER

CABINET AND CHASSIS
1—Peto-Scott screening box with three compartments, to specification. (Aluminium.)
1—Peto-Scott chassis for power unit to specification.

CHOKES, LOW-FREQUENCY
1—Ferranti B5.
1—Ferranti B1.

CHOKE, HIGH-FREQUENCY
1—Bulgin "Standard" Model or other type of 250,000-microhenries.

CONDENSERS, FIXED
6—2-microfarad.
3—4-microfarad.
2—6-microfarad.
1—8-microfarad.
1—.1-microfarad.
(*Note.*—The original amplifier contains a mixture of Dubilier and T.C.C. Any standard types can be used, subject to the obvious limitations of working voltages, which can be ascertained from the circuit diagram.)

CONNECTING DEVICES
1—4-way battery cable.
1—5-way ditto.
2—Bulgin P.9 4-pin cable plugs.
2—Bulgin P.3 5-pin cable plugs.

FUSES
2—Bulgin type F5.

JACKS
5—Peto-Scott double-circuit jacks.

LOUDSPEAKER
1—Field-excited type, resistance 1,000-ohm.

MAINS TRANSFORMER
1—Special Varley model.
(*Note.*—The transformer in the original amplifier was a Varley EP24 which is no longer listed, but another model is available giving the correct outputs.)

RESISTANCES, FIXED
2—1,000-ohm.
2—5,000-ohm.
1—40,000-ohm.
2—50,000-ohm.
2—100,000-ohm.
1—250,000-ohm.
1—500,000-ohm.
(*Note.*—The resistances in the original amplifier were of Ferranti, Varley and Graham-Farish make. Any standard types can be used, subject to the obvious requirements of current-carrying capacity. Reference to the circuit diagram will provide this information where necessary.)
1—resistance equal to T2 secondary impedance. (See text.) 10-watt size.

RESISTANCES, VARIABLE
2—50,000-ohm Rothermel-Centralab potentiometers.
1—100,000-ohm Rothermel-Centralab potentiometer.
1—10,000-ohm Rothermel-Centralab potentiometer.

SWITCH
1—Bulgin type S98 (double-pole change-over).

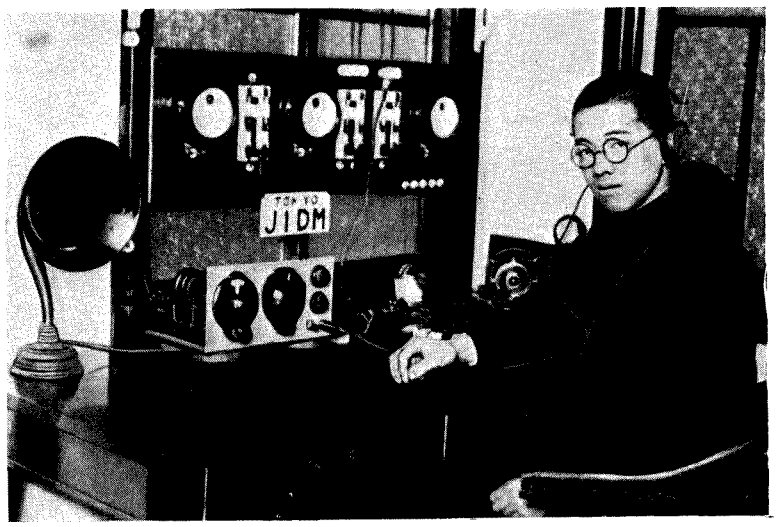
VALVES
2—Marconi or Osram MHL4 or Mullard 164V
2—Mazda PP5/400, Mullard DO26 or Marconi or Osram PX25 or 25A (LS6A can also be used if available. Suitable arrangements must be made about filament supply.)
1—Mazda UU120/500, or Marconi or Osram MU14.

VALVE HOLDERS
4—Baseboard mounting valve holders for amplifier.
1—4-pin chassis-mounting for amplifier (inter-connection device with power unit).
1—5-pin ditto. (Same purpose as above.)
1—4-pin chassis-mounting valve holder for power unit. (Rectifier.)
1—Ditto (inter-connection device with amplifier).
1—5-pin ditto. (Same purpose.)

TRANSFORMERS, LOW-FREQUENCY
1—Varley DP6 inter-valve push-pull.
1—Ferranti push-pull output transformer to suit loudspeaker.

WHAT YOU SHOULD KNOW ABOUT SHORT-WAVE DESIGN—No. 7.

The author now turns his attention to superhets for short-wave working, and he considers them to be the most successful types of all receivers. He discusses in detail his idea of a suitable super for short waves. We hope to publish a design on these lines during the coming autumn



R.P. photo.

Short-wave work is catching on in Japan. The number of amateur transmitters is steadily growing and here you see eighteen-year-old Seichiro Handa who operates J1DM at Tokio

Superhets for Short Waves

By G. HOWARD BARRY

SOONER or later this series on short-wave design was bound to arrive at the superheterodyne, which is, in a way, the most successful of all types of receivers. Right at the outset, however, let me clear the way by stating my own personal opinions very frankly.

When It's Good . . . .

I am convinced that there is nothing quite so bad as a *bad* superhet; and, similarly, that there is nothing quite so good as a *good* one. Unfortunately for all of us, the bad one is so very easy to make that it exists in prodigious numbers, while the really well-designed short-wave superhet is still something of a rarity.

Having disposed of that little thought, let me describe one of each kind. My idea of a thoroughly bad superhet is something like this: an autodyne detector-cum-oscillator, with no pre-selection, is followed by one or two high-gain intermediate-frequency stages operating at about 110 kilocycles. The second detector and low-frequency end are straightforward, and the reception of C.W. signals is possible by making the intermediate-frequency amplifier oscillate.

That is the particular brand of superhet that won't perform quite as well as the average one- or two-valve short-wave receiver. Second-channel interference will be perfectly ghastly; squeals and whistles from harmonics of the oscillator will abound; and C.W. reception, though possible, will take place amidst such a devastating background noise that it will be more or less useless.

Destructive criticism has never appealed to me, so that I must obviously place on record my suggestions for improving this type of receiver and for making something really workable out of it.

First, the autodyne detector must be scrapped. This used to be the subject of a specious argument on these lines: " On short waves, and therefore rather high frequencies, the small amount of de-tuning necessary to produce the intermediate-frequency beat with the incoming signal represents such a very small percentage of the actual frequency that we shan't lose efficiency."

All right, then. Let's admit that, for the purposes of the argument, although I don't really agree with it. What about the other half of the picture, though ? The fundamental disadvantage of an autodyne is that it is equally in tune with the wanted and unwanted signal.

Second Channel

Take a hypothetical case. We have an intermediate-frequency of 100 kilocycles, and are listening to a signal on 6,000 kilocycles (50 metres). If we use an autodyne it will have to be set either to 6,100 or 5,900 kilocycles, either position giving satisfactory reception. Suppose we leave it on 5,900 kilocycles, and on 5,800 kilocycles there is another strong station.

The 100-kilocycle beats produced with the wanted station on 6,000 and the unwanted station of 5,800 will just result in a nasty mess. You may argue that we could always change the tuning and go on to 6,100, but the chances are that there will be another unwanted station on 6,200 anyway.

First Improvement

You see, with an autodyne there is absolutely no possibility of distinguishing between the wanted and unwanted, both of which " look " the same to the intermediate

frequency amplifier. If we use a non-reacting detector and a separate oscillator and gang them together, we *have* improved things quite a lot. Imagine the above case under the new conditions.

To receive our 6,000 kilocycle signal our detector is tuned dead on 6,000 and our oscillator on 5,900. The unwanted man on 5,800 will be distinctly off tune with the detector, although the oscillator may beat with him just the same.

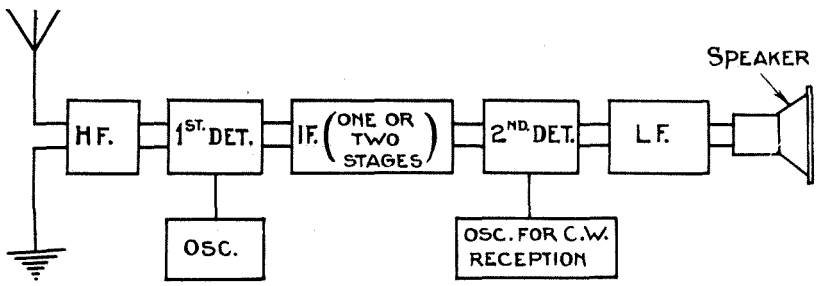


Fig. 1.—General scheme of the author's idea of a good superhet

Also our second channel will be weaker, because by the time we have tuned the oscillator to 6,100 our detector, which should be ganged with it, will be on 6,200 kilocycles.

I have dealt with this at length, because I want to stress this point very strongly: If you decide to use only two valves in the high-frequency portion of the set, it is vastly better to let them be a detector and a separate oscillator than a stage of high frequency and an autodyne detector.

Of course, it's better still to use H.F., detector and oscillator, all ganged together, and all the best short-wave superhets do use this scheme. If you like to combine the detector and oscillator by using a heptode or an octode, all well and good—you won't really have altered the circuit arrangement at all.

Intermediate Frequency

Next we must improve the intermediate frequency. One hundred and ten kilocycles is, in my opinion, a ridiculous frequency to use in a short-wave receiver, although it certainly makes for easy achievement of high efficiency. The standard American figure of 475 kilocycles is much more sensible, and will do much to eliminate troubles with second-channel interference.

One really well-built I.F. stage, and the rest of the set follows with an H.F. pentode operating on about 475 kc., will give all the gain that the average operator wants. Two will make the receiver a *real* loudspeaker proposition for quality reception, provided that the low-frequency end fits in with this ideal.

We are now getting to the stage at which we can call our receiver a *good* superhet, and its general scheme looks something like that shown in Fig. 1. The high-frequency side is shown in detail in Fig. 2, straightforward practice. Note that the coupling between the oscillator and the anode of the first detector is adjustable by means of the variable condenser C_1

The next question that arises is that of C.W. reception. I have already hinted that it is a pretty dreadful business to make the intermediate-frequency amplifier oscillate. For one thing, it should be built and arranged so that it *can't*; for another, it will generate an oscillation that is far too strong for the signal that it is intended to beat with.

For these reasons a separate long-wave oscillator may be regarded as essential for successful C.W. work. I use one that is entirely separate from the set itself generating quite a weak little signal. It need not be equipped with any form of variable tuning, since its function is just to provide a beat of constant frequency with the intermediate frequency in use.

Separate Oscillator

The whole thing *can* be separate from the set, coupling being arranged by a condenser taken from the grid of the second detector; or it can be built in with the set, in which case "strays" will probably provide sufficient coupling with the I.F.

Having said all this I must now confess that I don't like the superhet for C.W. reception, although I regard it as the telephony receiver *de luxe*. If you are going to try to use one for amateur-band C.W., it has got to be very, very good before it will get the better of a well-built, hotted-up two-valver. It has, in fact, to be a "Single-signal Super," about which I intend to talk next month.

Selectivity, both on the high-frequency side and in the I.F.

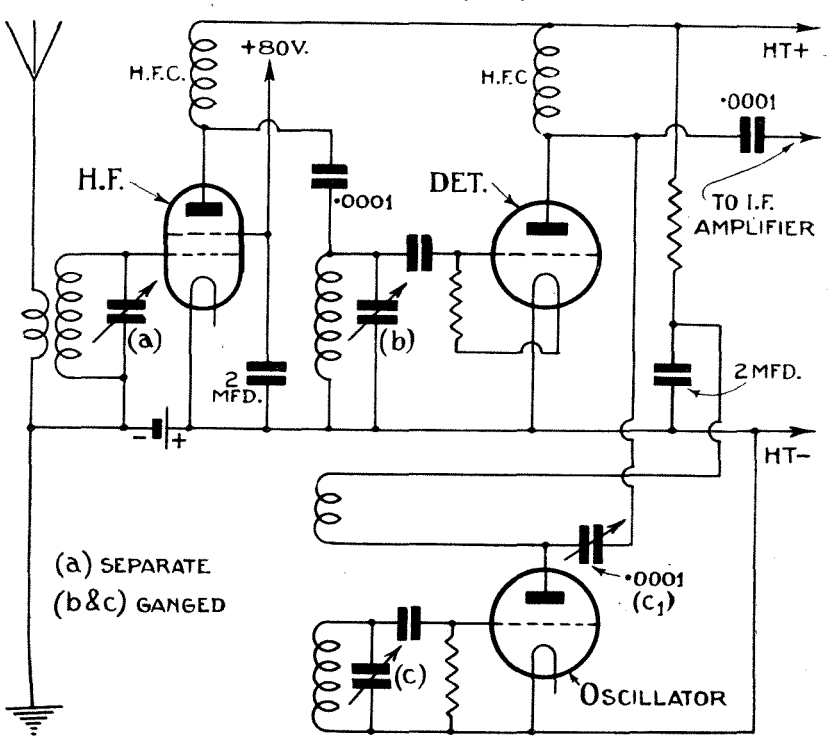


Fig. 2.—The high-frequency side of the "good" superhet shown in detail. C1 adjusts the coupling between the oscillator and the anode of the first detector

amplifier, has got to be of an extremely high order and that introduces new problems, such as the stability of the oscillator circuits.

Let us leave C.W. alone for the present, therefore, and concern ourselves with the reception of short-wave broadcast. Most of the important stations are grouped together in bands less than 400 kilocycles in width. It therefore follows that our set with an I.F. of 475 kilocycles will never be troubled with second-channel interference from another broadcasting station.

Unfortunately, the entire space between these bands is thickly populated by high-powered commercials, many of them using very fully-modulated interrupted C.W., which spreads in a most alarming way.

A Prime Necessity

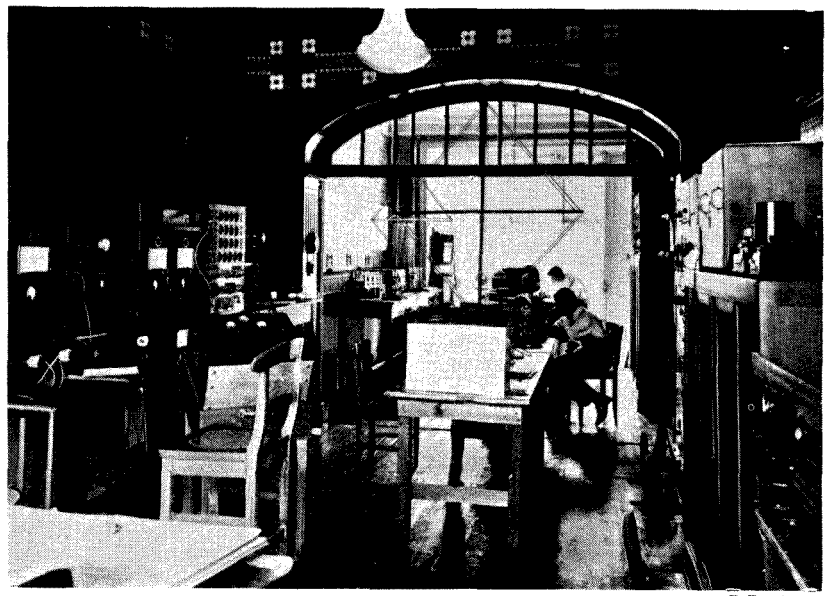
This makes our high-frequency stage a prime necessity and, owing to difficulty in obtaining really accurate ganging, I strongly recommend that the detector and oscillator should be ganged together and the H.F. control left separately. Really fine tuning on that stage will then be possible and, with any luck, it should be practicable to tune out interference of the very worst types.

At certain times of day, however, the distant station that you want to listen to will probably be extremely weak and the European commercial stations extremely strong. Under these conditions even the superhet collapses and there is nothing for it but to wait for half an hour or so—that is if you are unlucky enough to have severe second-channel interference from one of these super-power stations. The situation may never arise.

Superhet Adaptor

There is one more point to be covered—that of the superhet adaptor for use with an existing broadcast receiver. Once more, let's forget the autodyne at the outset and consider only the detector-and-separate-oscillator, whether two triodes or one heptode are used.

If the broadcast receiver is itself a superhet, a "double-superhet" effect is made use of, the input circuits of the set being tuned to about 550 metres (545 kc.). In most cases better results will be obtained in that way than by using the long-wave side of the set.



R.P. photo

The International Broadcasting Union at Geneva, is celebrating its tenth anniversary this year. This photograph shows the I.B.U. laboratory at Brussels where the wavelengths of all stations in Europe are checked

In the case of a straight receiver with a good high-frequency side, better results will be possible by tuning it to the longest wavelength that it will cover. If second-channel interference results, it will be necessary to come down and to sacrifice efficiency slightly.

A straight receiver with an inefficient high-frequency stage is *no good* for the purpose. Fortunately there aren't many of these about!

The usual method of coupling the superhet adaptor to the set is to use parallel feed for the detector, its anode being coupled through a .0001 microfarad condenser to the aerial terminal of the broadcast receiver.

Obviously the superhet adaptor is well worth consideration, since it saves the construction of more than half of the receiver.

Let us sum up the important points in the design of a good superhet. We require :—

(1) Efficient pre-selection, preferably with a stage of high-frequency amplification.

(2) Detector and oscillator circuits that are separately tuned, although they may be ganged.

(3) An intermediate frequency that is sufficiently high to reduce the risk of second-channel interference.

(4) A separate oscillator beating with the I.F., if C.W. reception is essential.

(5) A low-frequency side as good as that of the average good-quality broadcast receiver.

When all the above have been looked after, it will be time to think of (6) a good volume-control, preferably operating on one of the intermediate-frequency stages, in which position a variable-mu valve may be used with great success.

Broadcasting in Russia

DURING the past few months fantastic rumours have circulated regarding the feverish development of the Soviet Broadcasting Network. So far as can be ascertained, no great increase in either power or number has taken place since last year.

In an official publication issued by the Soviet authorities, only sixty broadcasting stations were mentioned; the powers varying from 1 to 500 kilowatts. Moscow (1), working on 1,724 metres, is the only transmitter possessing a power of 500 kilowatts.

The capital city possesses, however, three other 100-kilowatt stations, namely, RW43 (1,107 metres), RW49 (748 metres), and RW39 (360.6 metres). Leningrad and Novosibirsk also have each one 100-kilowatt station, but with the exception of Sverdlovsk (50 kilowatts) all other transmitters in the U.S.S.R. vary in power between 1 and 35 kilowatts.

J. G. A.

Many of the processes of modern valve manufacture call for the use of high-precision scientific apparatus. In this view taken in the Tungsram works some of the elaborate vacuum pump gear can be seen

WIRELESS FOR THE BUSY MAN—No. 4.

By PERCY W. HARRIS, M.I.R.E.

How the Valve Detects & Amplifies

We believe it a mistake to imagine that the radio public can be divided into two classes—those who make their own sets and are interested in the technical side, and those who buy ready-built sets and do not wish to know how they work. This series of articles is being presented on the assumption that many of our readers buy commercial receivers but do wish to understand the main principles of radio—perhaps without delving too deeply into technical matters. The response—in the form of appreciative letters—certainly indicates that our judgment was correct

LAST month I endeavoured in the space of a single article to give a general idea of the principles upon which the modern wireless valve is based. You will remember that so far in this course we have traced the wireless signal from the aerial up to the point where it has been magnified by one or more valves and has become a faithful copy of the current in the first tuned circuit, but of very much greater strength. We still have not reached that part of the apparatus where we can operate a loudspeaker.

Million a Second!

The currents are still "high-frequency" ones—tunable and rushing backwards and forwards in our circuit at the rate of perhaps a million a second, but varying at the same time in strength to correspond with the speech and music frequencies. Let us give a little more thought to what may be termed the "form" of the current at this stage, as it will help us to understand the next step better.

An ordinary electric lamp on alternating current mains is an excellent example of a piece of apparatus in which the *average* current is steady but in which it is periodically changing in direction and strength. House-lighting mains of the alternating current variety supply a current which rises and falls and changes its direction fifty times per second.

If you divide one-fiftieth of a second into four parts each of one two-hundredth we can start with the current at zero. At the end of the first two-hundredth of a second it has risen to its maximum, after which it starts to fall in strength so that at the start of the second two-hundredth it has once more reached zero.

It then starts to rise in the other direction or, put in another way, in opposite polarity, with the result that at the end of the third two-hundredth of a second it has reached the second maximum, while at the fourth two-hundredth (the end of the fiftieth of a second) it is back again at zero, having gone through a complete "cycle," as it is called.

Expressed slightly differently, we can say that the current rises to a maximum positive flow, dies down again and then rises to a maximum negative flow. A fairly good analogy can be obtained by considering the movements of water in a pipe connected to a pump in which the valve has gone wrong. The upward stroke of the pump first draws the water upward. Then as soon as the top of the stroke is reached the flow of water in the pipe ceases and on the plunger being pushed down again the water is expelled and flows in the opposite direction, until the bottom of the pump is reached by the plunger.

Fifty Times a Second

In house electric light mains the electric current is flowing backwards

and forwards in a similar kind of way fifty times a second, and as the *flow* of the current produces a heating effect we can use it to light our lamps.

Owing to persistence of vision in the eye you gain the impression that the light given from your lamp on alternating-current mains is steady, but actually it is flickering very rapidy above the speed at which the eye can notice any change.

A.C. Mains

The reason is that directly the current ceases to flow in either direction the heating effect ceases and the filament dulls down, whereas with the current flowing at maximum (at either of those moments I mentioned above) the heating effect will be the maximum. Thus the lamp is really becoming bright and dull alternately; between maxima it never fades right out because there is not time to cool down completely.

With certain apparatus it is possible to see this flickering. One way of doing it is to take a walking stick or ruler and swing it rapidly backwards and forwards underneath the light.

Interesting Test

If the movement is rapid enough so that the stick travels, say, 1 inch in a hundredth of a second, then you will see a row of sticks (or what appears to be a row of sticks) 1 inch apart!

This is because in the intervening periods the light has dulled down and has not been bright enough to illuminate the stick clearly. This is one of several possible tests which can be used to find out whether the mains are alternating or direct current, for this effect cannot be obtained with current which is steady in its flow.

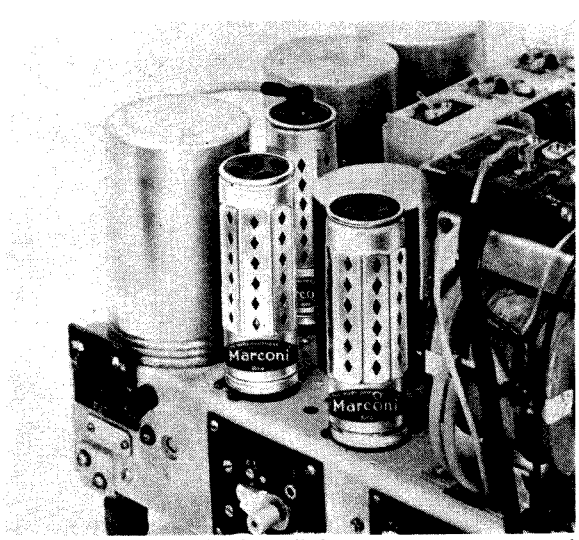
You can also buy from a gramophone shop a device known as a "stroboscopic" disc with lines on it which, when placed on your gramophone turntable, will seem to be stationary when revolving at either 78 or 80 revolutions per minute as indicated.

You will see why it appears to be stationary; with 50-cycle current and a certain speed of rotation each successive sector moves forward exactly the space between two sectors in the interval between the maxima of the light, so giving the impression that the sectors are stationary.

Now in wireless we are dealing with currents not of 50-cycles but on the medium broadcast band at frequencies of anything between 500,000 and 1,500,000 per second. If each successive rise and fall of current is of the same strength we get what we call a "carrier" and this has no sound on it because we cannot distinguish variations as high in frequency as 500,000 per second, much less 1,500,000 per second. (Just for your information, the highest note which can be perceived by the average person is in the neighbourhood of 10,000 per second and it is a very good wireless set which will reproduce anything above 6,000 or 7,000 vibrations per second so far as *sound* is concerned.)

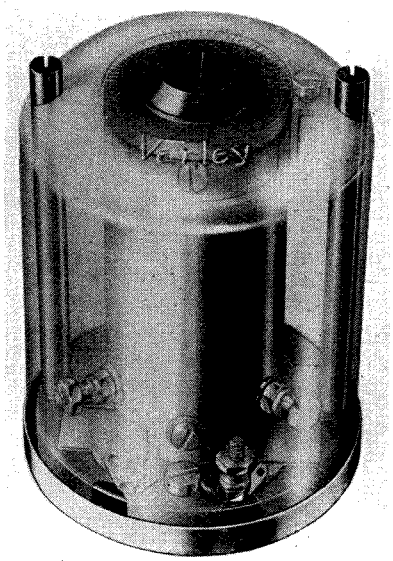
As I explained in a previous article, this rapidly varying high-frequency current has super-imposed upon it certain variations of strength corresponding with speech and music. Now we have made our current strong enough we can get rid of the high-frequency portion and concentrate on the speech and music vibrations.

The most common way of doing this is to use what is called a rectifying or detector valve, of which there are several forms. "Detector" valve is a silly term, but then wireless is full of foolish terms which have come to be accepted as its language.



An interesting type of valve called a Catkin employs a metal container in place of the more usual glass bulb

The simplest form of detector valve is one in which there is a one-way traffic arrangement or device which will allow the high-frequency currents to pass in one direction but not in the other, so that if we have some kind of electrical receptacle for these one-way pulses the energy will store up in it and accumulate as the high-frequency currents persist.



The screening of certain types of components plays a vital part in the design of the modern radio receiver. Here is a Varley unit shown in a manner which shows the interior assembly very much as though the metal can was made of glass

If, however, we arrange a leakage path for these currents the strength of the steady outflow of current will vary with the *average* variation of the high-frequency input current, or in other words, with the speech and music frequencies, the "high-frequency component" having disappeared.

Just One Reason

One of the reasons why we cannot put the high-frequency currents directly into a loudspeaker is that practically all loudspeakers are magnetic devices using a coil of wire with an iron core. It takes quite an appreciable time for the current to build up in one of these coils—appreciable, that is, compared with the 500,000 or more variations per second we were talking about—and if a current changes its direction too rapidly it will not have an opportunity to rise and do any work before the direction has been reversed.

Our rectifying valve or detector,

by getting rid of the high-frequency parts and leaving only the comparatively low-frequency rise and fall of the speech and music frequencies, enables us to pass a current through a loudspeaker which will work it. (Usually we add a little more magnification after the detector valve before coming to the loudspeaker.)

Numerous Methods

The kinds of circuit used in rectifying or getting rid of the high-frequency currents are numerous and somewhat complicated to explain. One of the most popular kind uses a condenser or storage device and a very high resistance known as a grid leak, which prevents the condenser choking up. The property of the valve which allows electrons or current to pass in one direction and not in the other is utilised for the " one-way traffic " idea and a certain amount of magnification is usually obtained at the same time; the accumulating charge on the grid varies the strength of the current flowing across the space between the plate and the filament, as explained last month.

Two-electrode Valve

Sometimes a special two-electrode valve is used with no grid—just a plate and a filament—at other times several electrodes are included in the same bulb so that the valve will act as a rectifier or detector and also as a magnifier at the same time.

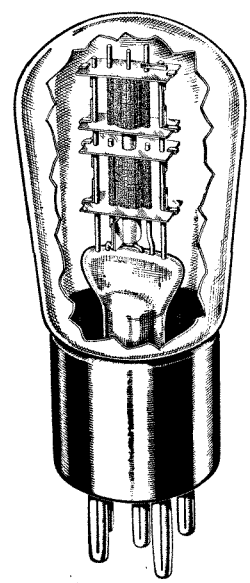
Indeed, it is not necessary to employ a valve at all and sometimes what is called a " metal rectifier " is used, this being a device in which a peculiar property of certain copper oxides is used to allow currents to pass in one direction and not in the other. The valve, however, is generally used because of its ability to magnify at the same time as you rectify—an action which is not possible with the metal rectifier.

On the output side of our detector we now have a current or voltage which is rising and falling in strength (without changing its direction) in accordance with the speech and music frequencies. We can apply this changing voltage to the grid and filament of a still further valve or valves and on the plate or output side we can arrange for the now greatly magnified current to flow to the loudspeaker.

Our high-tension battery- or mains-operated power unit, if connected through the coils of a loudspeaker to the plate of the last valve, will be passing a steady current when no signal is coming. Any variations of voltage on the grid of the last valve will bring about a change of resistance to the flow of current between the plate and filament.

Thus, when the steady voltage of the grid is made more positive by the input, the effective resistance of the valve goes down and more current flows from the high-tension source, whereas if the strength of the input falls the current flowing from between plate and filament will decrease. Remember it is the current supplied from the *high-tension source* which operates the loudspeaker, the incoming signals merely acting as a *control.*

Now if you think a moment you will realise that unless the current can rise and fall in correct proportion to the rise and fall of the input, our loudspeaker will not behave properly. Put in the conventional wireless language, if we want to get distortionless reception our output valve must be able to " handle " a strong signal without overloading.



The diode valve functions as a simple one-way device when used as a detector

Overloading generally means that after a certain point any further increase or decrease in strength of signals does not bring about a proportionate increase or decrease in the output current and this gives that nasty rattle, edginess or blasting in our loudspeaker.

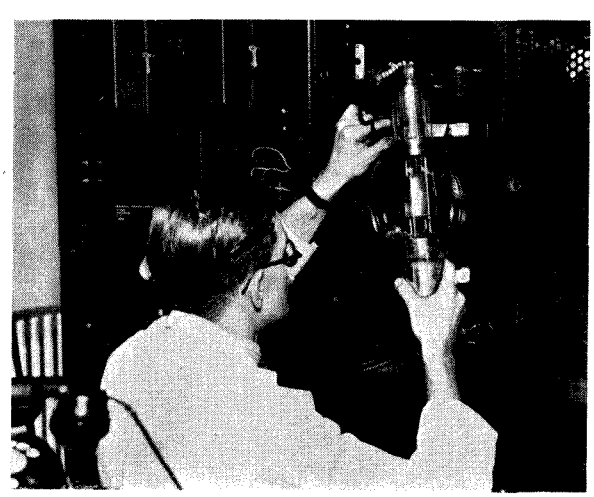
" Power " Valve

The output valve is generally called a " power " valve, not because it *makes* the signal powerful, but because it will *handle* adequate power. And adequate power, incidentally, depends not only upon the ability of the output valve to handle the signal properly but also on the ability of your high-tension source to deliver sufficient current.

This important point is often overlooked. A valve which will handle a powerful signal without causing distortion is very greedy of high-tension current * and, on the other hand the cheap high-tension batteries become exhausted very quickly if they are asked to deliver sufficient current for a powerful output valve.

One of the reasons why mains-driven sets usually give better results is not that the main principles are in any way different, but because it is very easy indeed with a mains set to provide fully adequate voltage and power for even the strongest signal without distortion. You *can* get just as loud and undistorted a signal with a battery set provided you have a large and powerful enough battery with sufficient voltage (250 volts or so) and sufficiently large individual cells to give plenty of current.

Remember voltage alone is meaningless. Voltage relates to pressure and current relates to quantity. It does not matter how high the pressure of a fire-engine pump is if all the engine will give is a needle-like jet of water, and the engine will not be much use if it gives a tremendous flow of water with no pressure behind it. In



Valves for special purposes are often very much bigger than those to which we are accustomed in radio reception. The example seen here is a high-power amplifying valve used by H.M.V. for gramophone recording

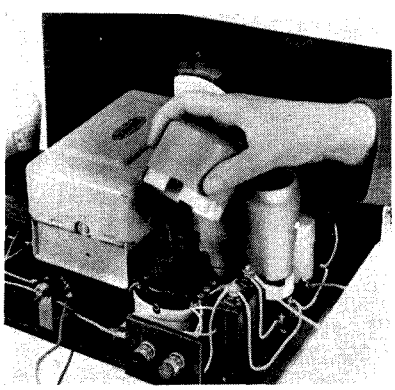
* There are one or two exceptions, to be described later.

wireless a 6-volt accumulator will give you plenty of current—far more than is called for to operate a loudspeaker, but the pressure is much too low.

Low Pressure

Similarly a high-tension battery gives much more pressure than is required for the filament of a valve but the ability to give current is limited. If you have a 100-volt battery and connect a 100-volt electric bulb to it you will get very little light because the relatively high amount of current required by the lamp is far greater than the battery is designed to give and so the voltage will drop rapidly and the battery become exhausted.

I have digressed for a few moments



For use in home-constructed sets, component screens are usually removable for access to the connection points

on this important subject of pressure and current because unless you are clear on the matter it will be difficult to appreciate the problems associated with the output of a wireless set.

Looking Back

Looking back, we have now seen how, after leaving the transmitting station, a wireless wave sets up minute currents in our aerial, how we select the frequency we want, magnify the currents, get rid of the high-frequency part so as to filter out the speech and music frequencies we require; how we magnify them still further and how in the output we are controlling the flow and strength of currents from our high-tension source.

Let us now take a glance at a modern wireless set—any one of the very well-made commercial receivers sold for home use—and examine it in the light of what we have discussed in these articles.

Prominently placed you will find the tuning knob, which nowadays is always connected to two or three or more condensers on one shaft so that all of the tuned circuits can be worked simultaneously. If you look inside the cabinet you may find the condensers cased in a box, but you will know where they are by the position of the spindle.

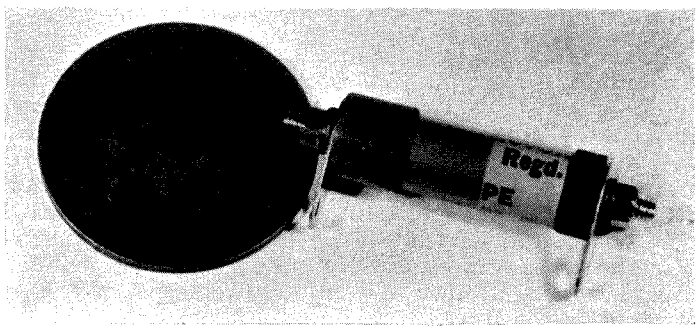
Frequently the vanes or moving plates which mesh with the fixed plates can be clearly seen, and as you turn the knob you will see them move more into or out of engagement with the fixed plates, thus varying the frequency to which the circuit tunes. The coils nowadays are practically always enclosed in metal cans to prevent their acting upon one another except in the way intended by the designer. Sometimes, too, the valves also are enclosed in cans, but more often than not in simple sets they will be in the open.

In order to give adequate electrical screening between the various parts it is common practice nowadays to make up the set on what is called a chassis of metal so very few wires show; the leads are taken along the underside to the various components. If, however, it is convenient to look at the underside of a modern wireless set you will see a mass of wires and all kinds of small " bits and pieces."

Most of these will be fixed condensers and resistances. In the main the purpose of these resistances and condensers is to reduce the voltages and to separate out the high- and low-frequency currents from one another to prevent unwanted interaction. High-frequency currents pass with the greatest ease through condensers and with some little difficulty through the resistances.

Direct currents such as we are supplying to the valve from our high-tension source, on the other hand, will *not* go through the condensers and so must go through the resistances. Once more, then, we have a one-way traffic idea applied to a sorting-out process.

Other controls on the set are the wave-change switch, which changes from one waveband to another merely by inserting additional coils (all are switched in simultaneously), a volume control which may work in several ways, one of which has already been explained, but always by reducing (early or late) the strength of the signal applied to the last valve. Sometimes, too, there is a control marked " range " or " reaction," which acts by taking some of the high-frequency current which has already been magnified and handing it back to be re-magnified to a greater or lesser degree.



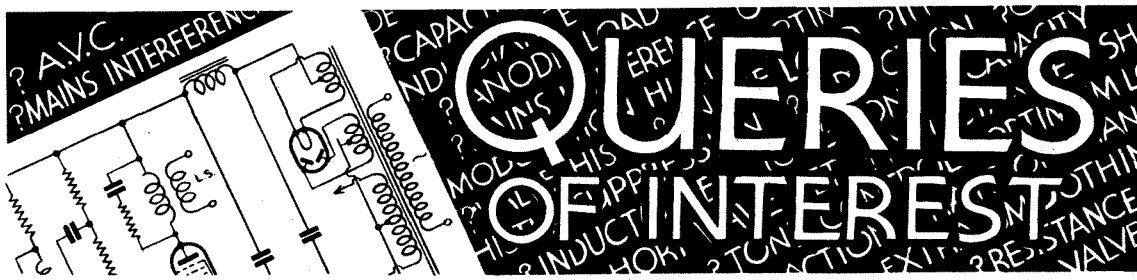
In some cases rectification is accomplished with the aid of a device employing the one-way properties of certain copper oxides

The effect of using this device is to increase the overall high-frequency magnification, but if this extra amplification is used to any great degree quality suffers and the set may " oscillate," as it is called, by handing back too much energy and making the valve act as a generator instead of a magnifier.

A Last Word

A final note. We have now reached a point where in our output circuit we have an electric current varying in strength. We intend to use this to operate the device which will turn these variations of current into variations of sound, so that next month we shall have to discuss a number of interesting points relating to loudspeakers and the ways of feeding them.

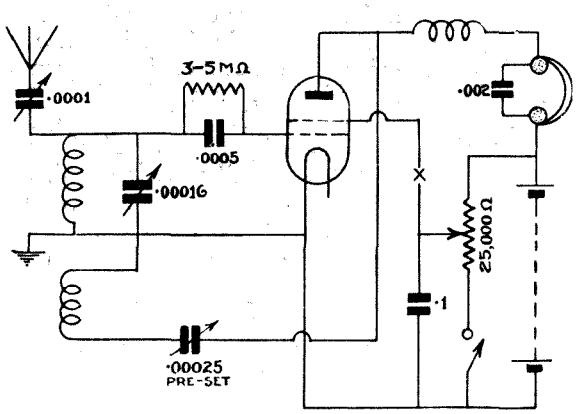
In closing may I ask readers who are following these lessons kindly to drop me a *postcard* stating as briefly as possible any points on which they would like further elucidation. It will not be possible to respond to these postcards individually, but they will be a great help to me in planning the subsequent articles.



The selection of questions and answers appearing below is the result of a search through our post bag in quest of matter which we consider of general interest and having a direct bearing upon everyday practical problems. The readers who actually asked these questions have, of course, received a reply through the post

"WITH reference to the article, 'How to get Smooth Reaction' in the January issue, I have been trying the circuit Fig. 6, and have encountered a difficulty. I agree that the arrangement gives extremely smooth slide-in effects, but I find some considerable difficulty in making accurate adjustments of reaction with the 25,000-ohm potentiometer. Any suggestions?"

We reproduce the circuit in question on this page, and it will be noted that fine adjustment of reaction demands close control of the voltage on the screening electrode of the screened-grid valve. This, in turn, requires that the potentiometer used be of a type capable of producing very small *changes* of voltage when the knob is manipulated.



Fine control can be obtained in a circuit of this type by inserting an additional variable resistance in series in the lead marked X

If the component chances to be one in which the resistance element is wound on rather a wide former, it is found that even if the sliding contact is capable of picking out its adjustment turn by turn, the variation of voltage is still in the form of quite abrupt steps of considerable magnitude.

The remedy in such cases, apart from the obvious one of replacement, lies in the addition of a special "fine-adjustment" control in the form of an extra resistance of the simple variable type in series with the lead which we have marked X on the diagram. The value of this is not in any way critical, and anything on hand may be tried; even the old-fashioned 400-ohm potentiometer may be worth a trial, making connection to only two of its terminals in the usual way.

Any other available value up to perhaps 5,000 ohms can be tried out. (The ideal value cannot be specified, because it depends upon the current consumption of the particular valve; it will usually be of the order of 2,000 to 3,000 ohms.)

This addition can be regarded as a desirable refinement in all cases, by the by, because it enables one to use any available potentiometer as the rough control without the necessity of seeking out one giving particularly smooth and accurate adjustment.

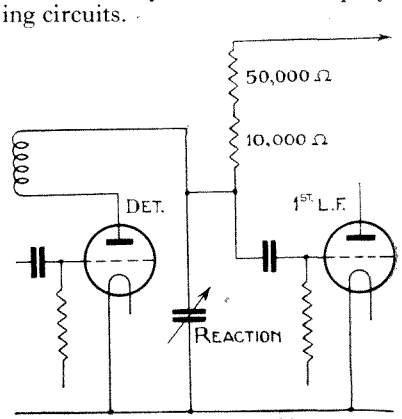
It is worth noting, too, that it is then permissible to increase the resistance of the component quite considerably and so effect a worth-while economy in high tension.

P. L. M., of Swanage, reports that he is building the Standard Four-valve Short-waver described in the March issue of "W. M." He is puzzled by the use of a 10,000-ohm resistance in place of an H.F. choke for reaction.

He points out that since this resistance is in series with the 50,000-ohm anode resistance, the L.F. voltages must be distributed between the two, yet only the voltage across the larger one is available for passing on to the next valve. He fears a loss of amplification and suggests instead the arrangement shown in the diagram reproduced on this page.

Our correspondent's surmise is quite correct; there *is* some loss of possible amplification, but it is very much smaller than he fears. Actually only one sixth of the total L.F. voltage is developed across the 10,000-ohm resistance and the remaining five sixths is passed on to the L.F. valve. This small loss is more than made up in any given case by the increased amplification rendered possible by the perfection of the reaction control yielded by this method.

The modification suggested would not be satisfactory. It would result in the grid circuit connection from the third valve being made to a point on the detector anode circuit where there are considerable H.F. potentials. In consequence H.F. currents would make their way into the L.F. amplifying circuits.



A reaction arrangement which is not advised

Is the Portable Worth While?

Including a Review of Some Familiar Models

By the "W.M." Set Selection Bureau

Just the set for the man of moderate means, this Lissen battery portable is a four-valver with a built-in moving-coil loudspeaker

HOWEVER worthy the portable receiver may be of a place in modern radio, we cannot but admit that its popular days are gone. Cast your minds back, say six years : it would be safe to say that portables were the first commercially-made sets to catch on. Even now there must be hundreds of listeners still in possession of their suitcase receivers with the long row of triode valves.

Times and fashions have changed. The portable has gone out of fashion somewhat, not because its design has stood still, but because the " indoor " set has beaten it by miles.

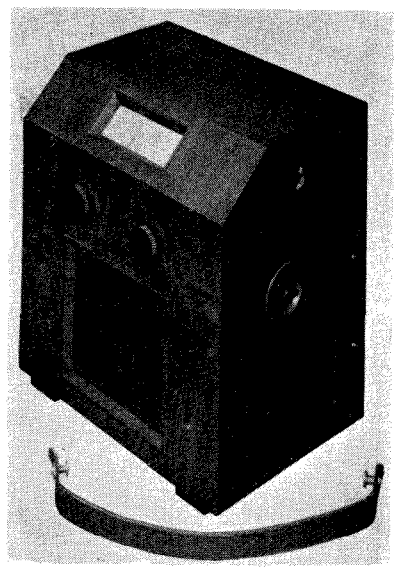
The modern battery portable, and that is what we are going to talk about, is really a worth-while proposition. One can carry it from room to room without worrying about electric light sockets; you can take it out in the car or have it in the garden. It is not, however, a proposition for hiking enthusiasts !

Those " snobs " on the mains will say : " What about quality, what about those big running costs ?" Fortunately, these are not worrying questions today.

The modern portable is economical to run, thanks to the use of multi-grid valves, and such output systems as class B, or by the use of economy pentode valves.

These sets are about the only types on the market to make use of built-in frame aerials, which offer many advantages. The main one is, of course, that the frame's directional properties are a great help in cutting out interference.

If one is listening to a foreign station, entertainment from which is being spoilt by a nasty whistle, more often than not if the set is moved round—the frame aerial pointing in another direction—and the volume control turned up to compensate for any loss in volume, we shall find that the whistle has almost disappeared. Of course, if the set has A.V.C. the apparent directional properties of the frame are much less pronounced.



Burndept's new Jubilee portable has a carrying strap that can be detached when the set is used indoors

The main criticism of the portable set is its reputation for bad quality. Even now we cannot say, nor are we going to pretend, that portable quality is as good as one gets from a standard indoor receiver worked off the mains, but the quality is as good as, and in many cases better than what one expects from a domestic battery receiver.

Modern portables will give good quality and plenty of volume. The majority of them are *not* expensive to run. There is, however, one point we wish to stress.

Like any other set, a portable has a limit to the amount of noise that can be squeezed from the loudspeaker. The volume control should be handled with discretion : keep the volume on the low side rather than turn it up and produce an overloading of the valves with its resultant noise.

We must all remember that in nine cases out of ten if we are using a portable in our gardens at home, others can hear as well, whether invited or not. The problem of loudspeakers of any sort out of doors is one that already is the cause of certain byelaws to prevent annoyance to others.

Our opinion is that all complaints received by the local authorities can be traced to *offensive* noises. Give your neighbour good quality, or shut up altogether !

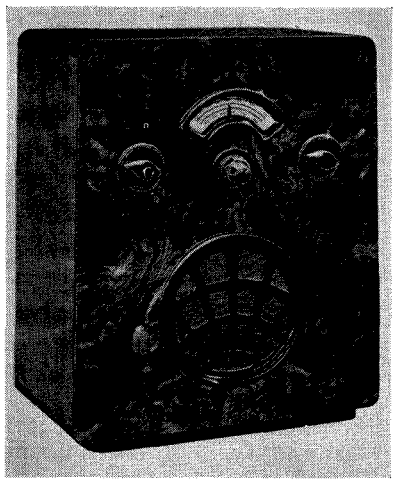
Choosing a Portable

When it comes to buying a portable receiver the question arises : " Shall it be a straight set, or shall it be a superhet?" Actually the difference among the better sets as far as sensitivity is concerned is not a lot. Naturally the superhet gives better selectivity and therefore the ability to produce plenty of foreigners as well as locals at night-time. But the straight set, we think, scores valve for valve during daylight hours as regards foreigners.

The prospective purchaser of a portable should make his choice purely on grounds of lowest running costs and the question of quality. That is a matter that can best be decided at the radio shop.

Besides the portable we have what has been named the transportable receiver. Seems rather a silly title, perhaps, but it covers a class of sets, both battery and mains-operated, that are handy for shifting quickly from one room to another.

The mains-operated transportable has its own built-in aerial; it needs no earth, the only external connection being made to an electric light socket.



The McMichael class-B battery transportable is an ideal receiver for all purposes. A test report appeared in the March, 1935, issue of " W.M."

Enjoyment is on tap in every and any room having an A.C. supply point with this Marconiphone 279 mains portable receiver

The value of this set can be appreciated without going into the question. Such sets are useful for garden use providing the necessary electric light supply is available.

Like the portable, the battery transportable needs no external connections of any sort. Convention has called it a transportable mainly because its shape and weight do not make it convenient for frequent shifting around.

Before we go into details about the sets available, let us point out the refinements that one usually gets with portables. Most of them, if not all, have illuminated tuning scales calibrated in wavelengths and station names. Provision is frequently made for external aerial and earth, a useful accessory should the user want extreme sensitivity indoors. Often there are sockets for a pick-up, another advantage not found with older types of sets.

And cost : not so expensive as you would imagine. Those listeners who spend most of their spare time in the open air should find a portable the ideal type of outfit.

Here are a few brief details of some of the sets available. For convenience sake they are dealt with in alphabetical order.

BURNDEPT

Of this firm's two portables, one is for battery operation and the other is for use on A.C./D.C. mains. Both are superhets and make use of a built-in frame aerial. The general arrangement of the circuit is similar for both battery and mains versions.

There is a high-frequency stage before the heptode frequency-changer, one stage of intermediate-frequency amplification, a high-frequency pentode as second detector, a Westector for providing automatic volume control, and a steep-slope pentode in the output stage.

As you can see from the illustration the makers have given consideration to the problem of transport without spoiling the appearance of the set. The carrying strap is arranged so that it can be taken off when not required.

Prices are quite reasonable : the battery model costs £11 11s., and the universal mains model £14 3s. 6d. The makers are Burndept, Ltd., Light Gun Works, Erith, Kent.

H.M.V.

The Gramophone Company lists two portables, a battery model known as the Superhet A.V.C. Portable Grand, priced at £15 15s., and an A.C. model, the Superhet Portable Fluid Light Six, at £16 16s.

Briefly, the battery portable is a six-valve superhet in a figured walnut cabinet having recesses in the sides which enable it to be gripped easily when being moved. One of

the chief features of this fine set is the provision of a Q.P.P. output stage using two matched pentodes which, besides ensuring plenty of volume, also ensures economical use of the high-tension batteries.

This set was tested by " W.M." in June, 1934 and, to quote from the test report, " the results obtained after dark were equal in every way to our standard six-valve superhet which uses an outdoor aerial."

The mains transportable is a six-valve (including rectifier) superhet with built-in frame aerial; a visual tuning indicator is one of its many refinements. This is a typical example of a handy house set that can be moved from room to room, for an A.C. supply socket is the only external connection necessary.

Full details of these two sets can be obtained from the makers at 98-108 Clerkenwell Road, London, E.C.

The battery portable is ideal for " quick " use in and out of doors. Here the H.M.V. Superhet A.V.C. Portable Grand is providing music to a patient in bed. Radio is a marvellous boon !

LISSEN

Lissen make only one portable, a four-valve class-B battery model moderately priced at £9 9s. The circuit comprises a screen-grid high-frequency amplifier, triode detector, and two low-frequency amplifiers, one being a class-B output valve.

Its many refinements include a polished oak cabinet complete with turntable on the bottom to facilitate turning the set around to get the utmost from the directional properties of the frame aerial. Provision is made for use of an external aerial and earth, and sockets are provided for connecting a pick-up.

This set is, no doubt, an excellent proposition for the man of limited means or for the listener who requires a second set for outdoor use.

Clapham and Dwyer with their Pye SP/B battery portable. We understand that these famous radio stars will be heard again very shortly

McMICHAEL

This well-known firm still favours the suitcase portable, and the present model, which sells at £15 15s., is one of the best known portables of today. The McMichael suitcase is covered with dark hide, and houses a four-valve battery receiver which feeds into a permanent-magnet moving-coil loud-speaker.

A feature of the set is that automatic grid bias is used and the only leads are two for the high-tension battery and two for the accumulator. The set has been reviewed previously in " W.M." and is one to be thoroughly recommended.

McMichael also markets two transportable receivers, a battery (class-B) model which sells at £14 14s., and a mains model, a superhet, at £16 16s. Full details can be obtained from McMichael Radio, Ltd., Slough, Bucks.

MARCONIPHONE

The Marconi-Men market one transportable only—Model 279, a six-valve (including rectifier) receiver with self-contained frame aerial for use on A.C. mains. This again is an ideal set for moving around the house, for the only external connection is an A.C. supply point.

Like all Marconiphone sets, this model 269 bristles with valuable features. It has full delayed automatic volume control—a system which eliminates blasting from powerful locals, minimises fading and, incidentally, reduces the directional effect of the frame.

There are four controls only. The set has a visual tuning indicator; a cabinet of figured walnut with inlays, and the output is just over two watts, which means more than enough volume for average requirements. The price is £16 16s.

The makers' address is Radio House, Tottenham Court Road, London, W.1.

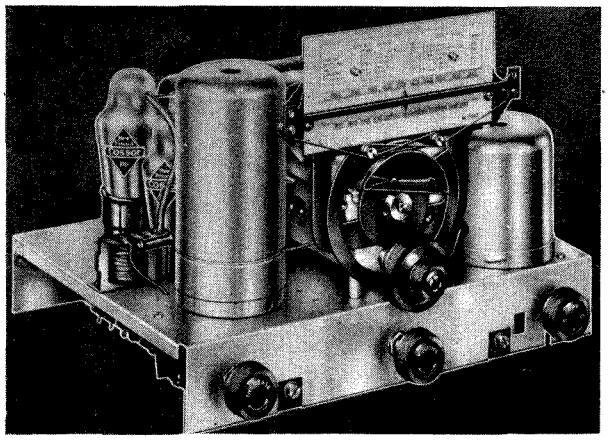
PYE

Pye's real outdoor portable is the model S/Q—a four-valve " straight " battery receiver entirely self-contained. The circuit is a well-tried one—a variable-mu high-frequency amplifier, detector, and two low-frequency stages utilising a pentode in the output.

The neat tuning escutcheon is marked in both stations and wavelengths. There are only two controls, one for tuning and the other for adjusting the volume. The loudspeaker is a moving-coil type. At its moderate price of £11 this set is a recommended proposition.

Pye also markets two transportable receivers, the models SP/B and SP/AC for battery and A.C. mains operation respectively. The makers' address is Africa House, Kingsway, London, W.C.2.

Cossor 369 A.C./D.C. Three



This model 369 employs three valves and a rectifier . . . quality is really tip-top

IT has taken a long while for listeners as a whole to appreciate the value of a receiver that works on both A.C. and D.C. mains without any alteration such as this Cossor set under review.

That such sets are coming into popularity is evident from the number of A.C./D.C. receivers—universal is another name—making their appearance.

The set under test is typically Cossor in both looks and performance—both are satisfactory. Our tests have been of an extremely exhaustive nature, the set having been tried out both in London and near Peterborough which is, by the way, in the Droitwich swamp area.

As you can see from the specification, this model 369 employs three receiving valves and a rectifier which only comes into use when the set is used on A.C. mains. The first valve is a variable-mu screened pentode and its grid-bias control together with reaction control forms the basis of the set's good performance, for with careful handling of these two controls one can take full advantage of the inherent selectivity of the iron-core coils used.

The set chassis is housed at one end of a neat walnut-finished cabinet of the familiar horizontal shape; at the other end is a permanent-magnet moving-coil loudspeaker with an 8-in. cone—a good point this! The cabinet itself is solidly made and is 20 in. wide, 13½ in. high and 10 in. deep.

The large full-vision scale—illuminated when the set is on—has at the bottom a scale marked in wavelengths, and above this is a chart of the best-heard stations together with their wavelength. This chart is removable so that new scales can be issued should any important wavelength shuffles take place.

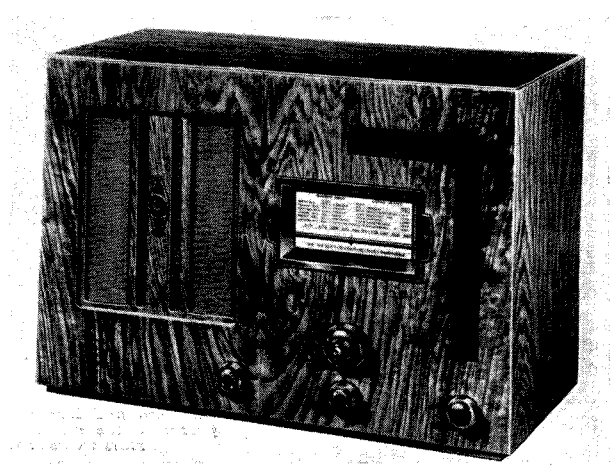
Underneath the scale in the centre is the main tuner with a superimposed trimmer—a useful thing this trimmer, for it enables the listener to get a station dead on tune. Underneath this is the volume control; to the left the reaction, and on the right a combined switch for long and medium waves, pick-up position and off.

We do want to impress on readers who invest in this or any universal receiver that the set chassis should not be fingered when the set is connected to the electric supply. Cossors make this important point quite clear in the extensive instructions, which should be read carefully before the set is installed.

Our first tests were made in London on A.C. mains. Conditions were definitely standard; a short 40-ft. aerial and good earth being used. Our first and lasting impression was the *entire* absence of hum. Subsequent tests on D.C. mains were found to give entirely hum-free reception.

Medium-wave selectivity was remarkable considering we were dealing with a straight three-valver. The only secret—and one easily learnt—is to get the balance between reaction and volume control just right. This means, when searching for really distant foreigners, plenty of reaction and a minimum setting of the volume control.

We found it quite easy to log Berlin, a few channels above London Regional, absolutely clear. Long waves in London were very reliable, too. We managed to log about seven stations in broad daylight, all at good entertainment strength. Even on the medium waves we could log six or seven foreigners at any time of the day.



A neat walnut-finished cabinet of the familiar horizontal shape . . . solidly made . . . a large, full-vision scale marked in wavelengths"

In the Midlands, using an unusually large aerial in a very open position, medium-wave reception was exceptionally good. Long waves, however, suffered somewhat from Droitwich's 150 kilowatts. It must be remembered that the locality near Peterborough, where the tests were made, is a bad spot for it suffers from "Droitwich swamp."

Quality is really "tip-top."

BRIEF SPECIFICATION

BRAND NAME: Cossor.
MODEL: 369.
PRICE: £8 18s. 6d.
TECHNICAL SPECIFICATION: Three-valve (excluding rectifier) receiver in table cabinet for operation on A.C. or D.C. supplies without any alteration. The valve combination consists of a high-frequency amplifier (Cossor 13VPA), high-frequency pentode detector (Cossor 13SPA) and super-power triode output (Cossor 402P). The rectifier, of the half-wave type, is a Cossor 40SUA.
POWER SUPPLY: A.C. or D.C. mains, 200-250 volts. (On A.C. supplies a frequency of 50-100 cycles is necessary.)
MAKERS: A. C. Cossor, Ltd., Cossor House, Highbury Grove, London, N.5.

Hyvoltstar All Wave Radiogram

THIS Hyvoltstar radiogram has a more ambitious specification than any model we have tested this year. To describe all its features at full length would exceed the allotted space, so we must be content to touch upon them all very briefly.

The major attraction is that the set chassis is a seven-valve superhet arrangement for operation on either A.C. or D.C. electric mains at will, and covers in addition to the normal medium and long wavebands the short waves between 13 and 53 metres. The actual arrangement can be followed easily from the data given in the specification panel.

Outside the set we must mention the Garrard automatic record changer, which will play ten 10 in. or ten 12 in. records without further ado. The merits of such a refinement have been dealt with at length in past reports. An added attraction, however, is that the Garrard assembly is now fitted with a crystal pick-up—readers are referred to our March issue for full particulars of this great advance in electrical reproduction of records.

THEN the loudspeaker is noteworthy. It is of the big Magnavox 66 type and will handle without any trace of rattle the 7 watts given by the set's push-pull output stage.

We are content to let the illustrations speak for the handsome cabinet. It is especially well-made of walnut and highly polished. Its size is considerable, being 3 ft. long, 3 ft. high, and 18½in. deep. One appreciates its good looks when the lid is closed; there are no controls on the front and its dignified appearance is enhanced by the plain loudspeaker opening backed in gold silk.

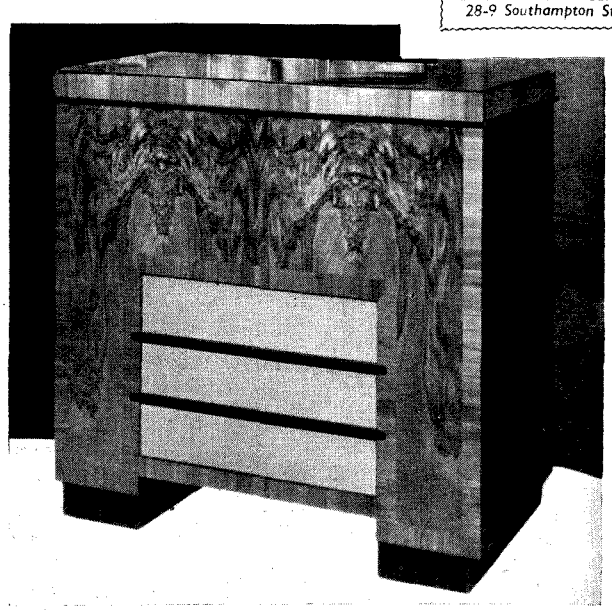
"There are six controls—six because the designers prefer to let one knob do one job"

Returning to the set. There are six controls—six because the designers prefer to let one knob do one job. There are no combination controls except one. The layout of the set's controls can be followed from the illustration. In the centre is the big tuning scale, calibrated—very accurately we found—in wavelengths on all bands including the two short (13-27 and 26-53 metres). To the left of this is a small aperture for the visual tuner—of the neon-lamp type.

The big tuning knob is in the centre; then from left to right are the controls for the tuning indicator, tone control, combined on-off switch and volume control, four-position wave-change switch and, finally, the gramo-radio switch. There are two controls on the record changer, one for on-off and the other for rejecting a record before it has finished playing in favour of the next on the pile.

BRIEF SPECIFICATION

BRAND NAME: Hyvoltstar.
MODEL: All-wave Superhet Seven Radiogram.
PRICE: £52 10s.
SPECIFICATION: Seven-valve (including rectifier) superhet radiogram for operation off A.C. or D.C. mains without alteration. Equipment includes an automatic record changer. The valve combination consists of a high-frequency stage (Ostar-Ganz V3), pentagrid frequency-changer (Ostar-Ganz G5), intermediate-frequency stage (Ostar-Ganz V3), two Westectors (WX6) for second detection and A.V.C., triode first low-frequency stage (Ostar-Ganz A520) and two super-power pentodes in push-pull (Ostar-Ganz M43). The twin half-wave rectifier is an Ostar-Ganz NG100.
POWER SUPPLY: A.C. mains, 25-100 cycles, and D.C. mains of voltages of from 190-260.
MAKERS: Universal High-Voltage Radio Ltd., 28-9 Southampton Street, London, W.C.2.



"We are content to let the illustrations speak for the handsome cabinet. It is especially well made of walnut and highly polished"

ONE word about volume. Undoubtedly this set gives enough "noise" to fill a large hall, yet—and this point is important—the volume can be turned down to ordinary room strength without loss of quality.

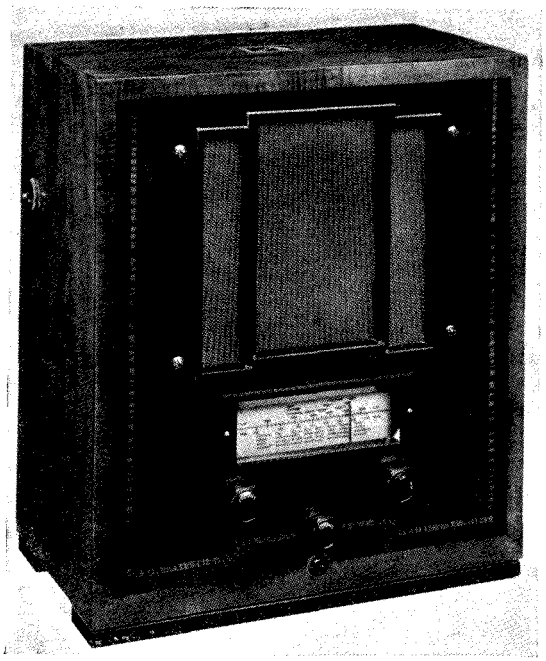
Our tests extended over two evenings and an afternoon, and during that time we tried the set out thoroughly.

Short-wave reception was, indeed, particularly good, and we had no difficulty in logging all the best European short-wavers, heaps of French, German and British amateurs besides all the morse stations in the ether!

We checked up the calibrations carefully on the Daventry Empire stations and found them to be exceedingly accurate.

On normal medium and long waves, the set behaved as a six-valve super should, though we found quite a deal of noise on the weaker foreigners when using our small indoor aerial. Selectivity, sensitivity and quality were good and the balance of tone struck us as being slightly above the average.

H.M.V. Universal Superhet Four



"Typical H.M.V. cabinet; of dignified appearance coupled with good solid construction"

THIS, if our records are correct, is the first A.C./D.C. receiver released by H.M.V. You note from the title that the makers have called it a "four." Actually only three receiving valves are employed, the fourth being a valve rectifier which comes into use when the set is used on A.C. mains.

Although only three valves are used in a superhet sequence, two are of the combined type and in effect we have three valves doing the work of six. This point will be made quite clear on studying the specification.

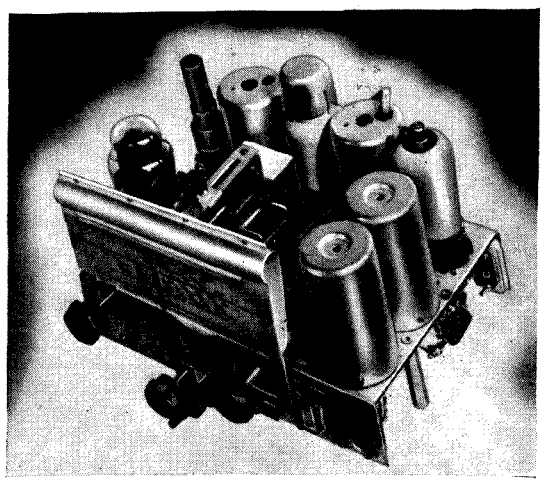
A very interesting point about the circuit is that the set's main volume control is part of resistance-capacity network between the low-frequency amplifying section of the WD30 and the output pentode. Actually what the volume control does is to vary the input to the grid of the output pentode.

The set is housed in a typical H.M.V. cabinet; of dignified appearance, coupled with good solid construction. Controls are especially simple. On the front beneath the large loud speaker opening is a full-vision tuning scale — illuminated when the set is on — marked in wavelengths and with the names of some forty-four of the best-known broadcasting stations.

Beneath the scale we have the three main tuning controls; on the left the volume control, the main tuner in the centre, and the wave-change switch on the right. You note that there are no combination controls. The on-off switch is mounted on left side of the cabinet.

Underneath the main tuning control is a two-point sensitivity control; full sensitivity is obtained when the button is pushed in—only powerful foreigners and locals are heard when the button is in the "out" position. In the latter position, of course, there is hardly a trace of noise or background, and is an asset which makes the set ideal for those requiring high-class reproduction.

The layout of the set inside is neatly arranged. The chassis is at the bottom, and on the back are the sockets for aerial—two, one for long and the other for short aerials—and earth. No provision is made for the use of a pick-up with this H.M.V. model 340 A.C./D.C.



"Layout of the set inside is neatly arranged . . . . . no provision is made for a gramophone pick-up"

The set has been in use on and off for some three weeks during tests, the longest continuous period being fifteen hours and we have not found any signs of distress. We are of the opinion that very great care has been taken by the designers to put out an A.C./D.C. receiver that is really reliable.

Of special interest are the results we obtained during a morning test in May. The set was tried out in South London on our standard outdoor aerial about 50 feet long. The results in broad daylight were really nothing short of startling. We heard such foreigners as Stuttgart, Brussels, Poste Parisien, Hilversum, and Radio Normandy, at full loudspeaker strength, with no great amount of noise. We have always been of the opinion that one of the main disadvantages of the small superhet is its limited daylight range. This set certainly seems to be an exception.

At night all the stations listed on the dial came in very satisfactorily.

Quality is very good, moreover we found no trace of mains hum, even when the earth was disconnected.

Altogether we must give H.M.V. the credit for producing a very fine A.C./D.C. superhet !

BRIEF SPECIFICATION

BRAND NAME : H.M.V.
MODEL : 340 A.C./D.C.
PRICE : £12 1s. 6d.
VALVE COMBINATION : A four-valve (including rectifier) circuit arranged in superhet sequence. The first valve is a heptode combined detector-oscillator (Marconi X30), then follows a single intermediate-frequency amplifier (Marconi WD30), which also combines the functions of second detector and the first low-frequency amplifier, the output from which is resistance-capacity coupled to an output pentode (Marconi N30). A valve rectifier (Marconi D30) is brought into use when the set is operated on A.C. mains.
POWER SUPPLY : A.C. or D.C. mains, 195 to 255 volts (on A.C. mains the frequency must be between 25 and 60 cycles).
MAKERS : The Gramophone Co., Ltd., 98-108 Clerkenwell Road, London, E.C.1.

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To the WAVERLEY BOOK CO. LIMITED,
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Please send me, carriage paid, for seven days' FREE examination, "THE ELECTRICAL ENCYCLOPEDIA," complete in four volumes. It is understood that I may return the work on the eighth day after I receive it, and that there the matter ends. If I decide to keep the books I will send you on the eighth day a First Payment of 2/6, and, beginning thirty days after, thirteen further monthly payments of 5/- each and a final one of 6/-, thus completing the purchase price.
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Wi.Mag.1. 1935. **PLEASE FILL IN ALL PARTICULARS**

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The new range of Dubilier Condensers marks the greatest advancement in Condenser design and more than maintains Dubilier's established position as the foremost manufacturers of the highest quality products at the lowest possible prices. It would pay you to be more familiar with the latest developments in condenser design. The new Dubilier Booklet tells you all there is to know. Write for your free copy.

G. 3

DUBILIER

★ CONDENSERS

DUBILIER CONDENSER CO. (1925) LTD.,
DUCON WORKS,
Victoria Road, North Acton, London, W.3

Mention of the "Wireless Magazine" will ensure prompt attention

Cicely Courtneidge preparing to part with her cheque of £100 to Cyril Ray and Ivor McLaren, two young British composers, who accepted her wager that no suitable British patriotic song could be produced to-day

Records

A Review of the

IT is really only when one has a huge pile of records—new releases—that one realises what marvellous music there is on tap for the radiogram owner. This month's records, particularly, set a standard that will be hard for the record companies to beat. Many Jubilee records are still being issued.

There are two great records which I recommend to all, *Cavalcade of Famous Artists*, on H.M.V. DB2454 and DB2455 (6s.). Not only have we past and present masters of musical interpretation, but we have them giving us music that we all know. Caruso sings *On With the Motley*, Rachmaninoff plays his famous *C Sharp Minor Prelude*, Pachmann plays us Chopin, as only Pachmann can—and makes two starts because he does not like the first—Kreisler plays *Caprice Viennoise*, Count John McCormack sings that old ballad, *Love's Old Sweet Song*, Pablo Casals plays on his 'cello Beethoven's *Minuet in G*, and so the records go on with Melba, Backhaus, Chaliapine, Galli Curci, and last the late Sir Edward Elgar conducting a *Pomp and Circumstance* March. No further comment from me is necessary.

Billy Cotton, one of the most versatile of dance-band conductors, records for Regal-Zonophone

While on classics, Sittard playing *Dorian Toccata* on the organ of St. Mark's Hamburg, and Heinrich Schlusnus singing *The Drummer* and *Biterolf*, are two records that every keen listener should get. I have never heard a better organ record than Sittard on Decca-Polydor PO5118 (2s. 6d.), and Schlusnus' singing of two of Hugo Wolf's best songs is one of the finest Lieder records ever issued (Decca-Polydor DE7032, 2s. 6d.).

Historic records are all right as long as they provide entertainment as well as history. For this reason I recommend a performance of the *Coronation March and Hymn*, played by the London Philharmonic Orchestra, under Sir Landon Ronald, on H.M.V. DB2438 (6s.). A fine twelve-incher, this!

There are exceptions—there must be—and one is *Jubilee Scrapbook* on Columbia DX686 (4s.). In this record, which touches on the outstanding moments of the past twenty-five years, we have the Countess of Oxford and Asquith relating what happened before the Ultimatum, which brought us into the Great War, expired. She describes how she waited with Mr. Asquith—as he was then—for a reply from Germany, which never came. Certainly a record for every connoisseur. I strongly recommend this.

Beethoven is represented in this month's collection by his *Kreutzer Sonata*, which is beautifully played by Yehudi and Hephzibah Menuhin on H.M.V. DB2409 to 2412 (24s., in an album). I bring it to your notice as an outstanding production, but it is really a record for the keen musician.

Having disposed of "the classics," now for records that most of us will appreciate. And there are some good ones!

The Cads (Western Brothers to be precise) give us *We're Frightfully B.B.C.* and *Keeping Up the Old Traditions*, on Columbia DX685 (4s.). I can't say what I think about this record, but I am allowed to wonder whether, well... The B.B.C. has a knack of banning even the most harmless of gibes!

I do like, very much, Sidney Torch's *Bugle Call* and *Twelfth Street* Rags on Columbia DB1535 (2s. 6d.). Recording is brilliant and if you like hot organ music this is an opportunity not to be missed. It was recorded in the Regal Cinema at Edmonton.

Two good Decca twelve-inchers are *Memories of Horatio Nicholls*, played by Harold Ramsay and his Rhythm Symphony on K752 and Ambrose's *Jubilee*

for Your Radiogram

Latest Record Releases by T. F. HENN

Cavalcade on K750. In the first we have some good old tunes, *Dream of Daylight*, *Wyomin'*, *Babette*, *Sahara*, *Souvenirs*, and so on; in the second we have all the popular song successes of 1910 to 1935. Ambrose is certainly in his most brilliant style here. By the way, I have been referring to the price of Decca K records as 3s.; they are actually only 2s. 6d.

Henry Hall goes all modern and sinister in *Southern Holiday*, which is described as a phantasy of Negro moods. It is by Reginald Forsythe, whose New Music you have probably heard over the air. Columbia are good enough to tell me that his music created a sensation in America and resulted in his being offered a five-year contract. I took the record to some friends; they offered me five years, but not in America. Very brilliant, but rather inclined to set one's teeth on edge!

If you are a lover of the Wireless Military Band, try the *Vanity Fair* Overture (Fletcher) on Columbia DB1537. I like band music, but not as played by this band; they seem to play the wrong music, or is it that they play it in the wrong way?

There are two particularly strong vocal records. One is John Hendrik singing *Glamorous Night* and *Shine Through My Dreams*, both by Ivor Novello and from the new show *Glamorous Night*, now at the Theatre Royal, Drury Lane. Well sung and very tuneful. (Parlophone R2058, 2s. 6d.).

The other is two very popular songs by that favourite broadcaster, Harold Williams. He sings *Shipmates o' Mine* and *When the Children Say Their Prayers* (Columbia DB1536, 2s. 6d.). A splendid record! I think that this is the month's best.

Cicely Courtneidge was deprecating at a musical gathering some time ago, the glut of what she called "sickly songs about coloured moons, sweeties, etc.," and she threw down a wager of £100 that a suitable English patriotic song would not be forthcoming.

Two young British composers, Cyril Ray and Ivor McLaren are now richer by £100. They are the composers of a song, *Gentlemen the King*, which Cicely Courtneidge thought was worth the £100. It is recorded on H.M.V. B8314 (2s. 6d.). You heard the song broadcast during the Jubilee programmes. It is good!

One good light orchestral record. *Le Cygne* and *Evensong*, played by Leslie Jefferies and the Grand Hotel, Eastbourne, Orchestra. It is on Parlophone R2065 (2s. 6d.).

Bing Crosby's record of the month is *Soon* and *Down by the River*, on Brunswick WF1994 (2s. 6d.). When you hear Bing croon, be careful, you may be converted to the ranks of "croon-fiends." This is one of his really brilliant efforts.

Perhaps you like the Les Allen style. He sings *An Earful of Music* and *When My Ship Comes In* on Columbia DB1540.

Two piano records—of the light syncopated type—will appeal to those who have an ear for peppy tunes. They are *A Keyboard Medley*, played by Arthur Young and Harry Jacobson on Decca F5500, and a *Waltz Medley* by Harry Roy's Tiger-ragamuffins on Parlophone F147 (1s. 6d.).

And now for dance music. The merits of the various records can be judged by the number of stars; the more stars the better the record *in my opinion, of course*. All cost 1s. 6d., except Regal, which are only a shilling.

***Sweet Rosita* (rumba), *So Red the Rose* (foxtrot), Eddie Carroll and His Music, Parlophone F150.

***Foxtrot Medley*, Nat Gonella and His Georgians, Parlophone F14.

***March Winds and April Showers* (foxtrot), *Dream Man, Make Me Dream Some More*, Harry Roy's Band Parlophone F145.

**There Won't Be Any Spring* (foxtrot), *Marie Louise* (waltz), Jack Jackson and His Orchestra, H.M.V. BD153.

****No Words—Nor Anything*, *Temptation Rag*, Bugle Call Raggers, Decca F5479.

**The Bridal Waltz*, *Andalusia* (six-eight), Billy Cotton and His Band, Regal-Zono, MR1671.

**Cherokee* (slow foxtrot), *My Dance* (foxtrot), Lew Stone and His Band, Regal-Zono MR1674.

The Countess of Oxford and Asquith describes the tense moments of August 4, 1914 on a new Columbia record, "Jubilee Scrapbook," issued this month

News from the Radio Societies

Conducted by G6QB

Under this heading we publish reports every month of the activities of short-wave and transmitting societies. We shall be pleased to give publicity to any announcement of forthcoming events, etc., and secretaries of short-wave societies, whether national or local, are asked to make the fullest use of this space

Radio Society of Great Britain

THE event of the Summer—National Field Day—takes place on June 1 and 2. Details were given last month in these notes. Unfortunately the complete list of stations taking part will not be available in time for publication in this issue, but will be found in the *T. & R. Bulletin* for this month.

Non-members who are interested should make themselves known to a local member and are, in most cases, welcomed as visitors at the field stations, provided they do not stay too long or talk to the operator !

The two South London stations will both be situated in Kent. The 160-metre and 80-metre station (about which I hope to give first-hand information at a later date) will be at Ide Hill, near Sevenoaks. The other, working on 40 and 20 metres, will be between Biggin Hill and Westerham Hill.

Both locations are excellent and it is hoped to run a 5-metre link between the two stations for interchange of news, emergency calls for supplies, etc.

R.S.G.B. members have been circularised with a view to ascertaining whether they prefer the Annual Convention to be held, as usual, during the period of the Radio Exhibition or at a date towards the end of September.

Many members are connected with the trade and have to be in London during the Exhibition. This, however, cuts both ways as some of them are too busy at the Show to attend Convention, while others find it their only opportunity of getting down to London.

Individual members, as well as groups of the R.E.S. (Research and Experimental section) have been putting up good performances during the past month or so. At least one member has succeeded in contacting with the U.S.A. on the 160-metre band with *ten watts* input—in itself no mean feat.

At the other end of the spectrum, 10 metres remains a complete mystery. Australian members of the B.E.R.U. have been in touch with both sides of the American continent as well as with Japan, and the Belgian station ON4AU is being heard in the States. In this country, however, everyone still reports "nothing doing." Apparently the zone of good 10-metre conditions is taking some time to reach us.

The Australians are also doing great things on 5 metres, which one can understand when one sees the amount of space that the average Australian amateur has available for the erection of beam aerials and the like. Also, large tracts of flat country are more common out there than they are at home !

Great Britain is not far behind in this sphere and activity is increasing every day. There must be over thirty London stations regularly using the 5-metre band and contacts over 15 miles or so are becoming quite common.

Operators of mobile and portable stations in the Surrey hills find no difficulty in covering greater distances than this with minute inputs and ordinary di-pole aerials, without elaborate reflector systems.

AN INVITATION

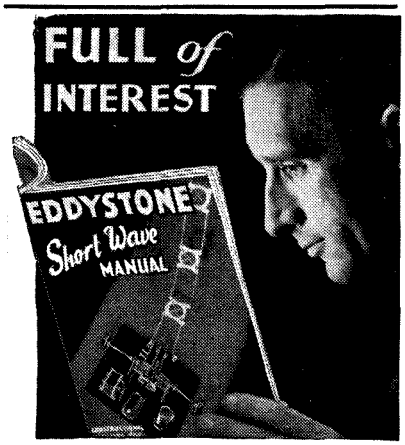
Secretaries of short-wave and transmitting societies are invited to make full use of this new feature in "W.M." Contributions and notices should be addressed to G6QB, c/o the Editor, "Wireless Magazine," George Newnes, Ltd., 8-11 Southampton Street, Strand, London, W.C.2

At the I.E.E. meeting of the Society on April 24, Mr. G. Parr, of the Edison Swan Electric Co., gave an extremely interesting lecture on the cathode ray tube and its application to television and radio research. It is hoped that he will give another lecture, and a demonstration, at the Annual Convention.

International DX'ers Alliance

The London (Epsilon) Chapter held a successful meeting on April 16 at the Chequers Restaurant. Recent club activities include short- and medium-wave DX contests, a component exchange club, and several visits to places of interest to radio enthusiasts.

Prospective members in the London district are asked to apply to the Publicity Manager, Arnold G. Ward, 59 Balaam Street, Plaistow, E.13. Others interested in the activities



Fully illustrated with constructional details for building Battery and Mains S.W. Receivers—6v. S.W. Super-het with A.V.C.—All Wave Wavemeter—5-metre Receiver—Simple 5-metre Transmitter—Crossfeeder Aerial System—Battery and Mains S.W. Converters—Amateur Bands Receiver—100 watt Transmitter—Eliminators, etc., COMPILED BY THE LEADING SHORT WAVE SPECIALISTS. Obtainable from your radio dealer, W. H. Smith, or in case of difficulty, STRATTON & Co., LTD. (Dept. 25), Bromsgrove Street, Birmingham. London Service Depot :— Webb's, 14 Soho Street, W.1. Glasgow Service :— J. R. Hunter, 138 West Nile Street. PRICE 1/6

1935 EDDYSTONE SHORT WAVE MANUAL

of the I.D.A. should write either to R. L. Rawles, Blackwater Corner, Newport, Isle of Wight, or W. W. Warner, 56 East Grove Road, St. Leonards, Exeter, Devon.

Radio, Physical and Television Society

The above society, with headquarters at 72a North End Road, Kensington, is anxious to obtain new members. Applications should be sent to M. E. Arnold, 12 Nassau Road, Barnes, S.W.13.

Whitstable Short-wave Club

Any readers in Whitstable, Tankerton and district who are interested in short- and ultra-short-wave work and are desirous of helping the existing small band of members in the district to make this club a success are asked to communicate with the secretary, W. Crossland, "Griz-Nez," Queens Road, Tankerton, Kent.

Lanarkshire Short-wave Club

Readers who are interested in the formation of a short-wave club in Lanarkshire are asked to approach Mr. W. L. Horner, 11 Kirkland Park Avenue, Strathaven, Lanarkshire. A few enthusiasts have already done so and it is hoped, shortly, to form a successful club for the pooling of knowledge and experience.

Secretaries Please Note

Secretaries of small local clubs are missing the opportunity of valuable publicity by not coming forward and proclaiming their existence. This space is at their disposal.

There must be hundreds of local gatherings of enthusiasts which, even if they do not call themselves clubs or societies, would welcome new members.

Piezo Electricity

A Technical Treatise on the Applications of Rochelle Salt Crystals to High-fidelity Sound Reproducers

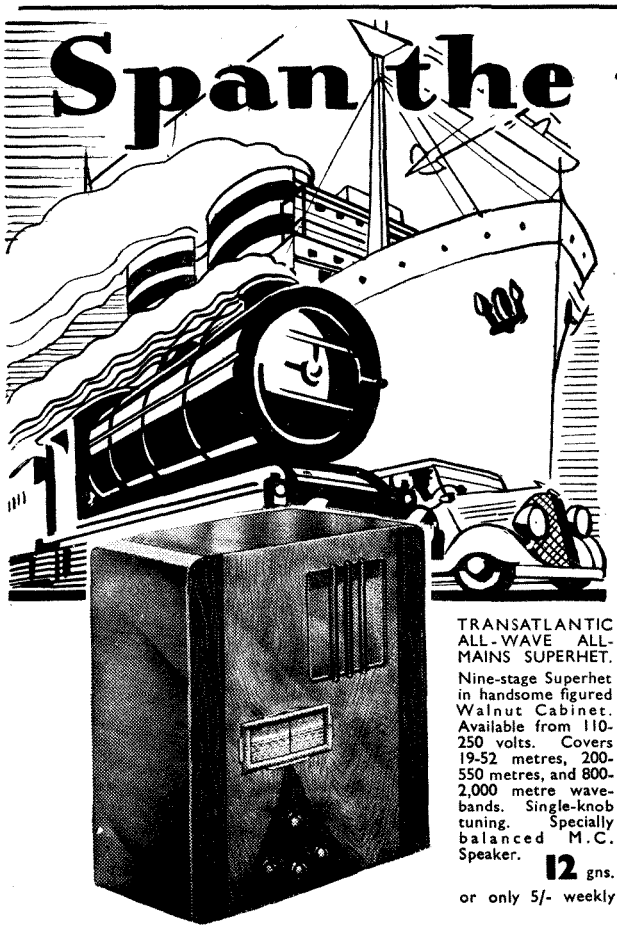
WE have devoted a large amount of space recently in "Wireless Magazine" to articles on piezo-electric pick-ups and Tweeter loud-speakers. We have now received from R. A. Rothermel, Ltd., of Canterbury Road, Kilburn, London, N.W.6, a thirty-two page book which deals very thoroughly with all the various applications of Rochelle Salt to radio components.

For instance, there are some five or six different types of microphone, various speakers besides the Tweeter and, there are the two pick-ups.

Not only are all these components described, but there is valuable information given on using them so that experimenters can get the *real* quality which we know is capable of being given.

This book is indeed a comprehensive guide to the use of piezo-electric components. The foreword is written by P. Wilson, M.A., who, as you know, is a regular contributor to "Wireless Magazine."

The price of this book is 9d., post paid, and is obtainable from R. A. Rothermel, Ltd., it is not obtainable through the "In Tune With the Trade" free service.



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In Tune with the Trade

EXAMINER'S Review of the Latest Catalogues

SEND TO US FOR THESE CATALOGUES!

Here we review the newest booklets and folders issued by five manufacturers. If you want copies of any or all of them, just cut out this coupon and send it to us. We will see that you get all the literature you desire.

Please indicate the numbers (seen at the end of each paragraph) of the catalogues you want below:—

My name and address are :—

Send this coupon in an unsealed envelope, bearing ½d. stamp, to "Catalogue Service," WIRELESS MAGAZINE, 8-11 Southampton St., W.C.2.

Valid till June 29.

PYE OF CAMBRIDGE

THIS well-known radio firm has just issued an attractive new broadsheet in colours giving complete details of the Pye range of receivers—portables for battery and mains operation, ordinary mains domestic receivers and handsome radiograms.

I notice that Pye market a permanent-magnet moving-coil loudspeaker in a handsome walnut cabinet, with a choice of two shades of fabric behind the grille, for as little as £3 9s. 6d.

The big point about this speaker is that it is provided with a universal matching arrangement whereby, the makers claim, it can be used with any type of receiver.

Most of us have our home receiver carefully fixed—like the family safe—in one place. A length of wire and a speaker, such as this, enables one to have music on tap in any room—even in the bathroom ! **461**

ERIE'S VALUABLE BOOKLET

ERIE, the resistance people, has issued a booklet called "Useful Technical and Design Data Applying to Erie Resistance." How valuable this booklet is cannot be appreciated at one sitting; it is chock full of valuable information.

First of all one finds the R.M.A. Colour Code set out in great detail; then there is some useful information concerning temperature rise with load, voltage coefficient, temperature coefficient and other useful data dealing with resistances.

This booklet has my strongest recommendation, and a copy is yours for the asking. **462**

MAZDA POCKET CATALOGUE

THE keen radio man should have an up-to-date knowledge of the range of Mazda valves on the market. And the simplest way to do this is to ask for a copy of the Mazda pocket guide recently issued. In this one finds all the various ranges — battery, A.C., and A.C./D.C.—carefully listed so that one can find any particular type quite easily.

A useful point in this catalogue is that each valve is fully described in a manner that can be best described as "not too technical." **463**

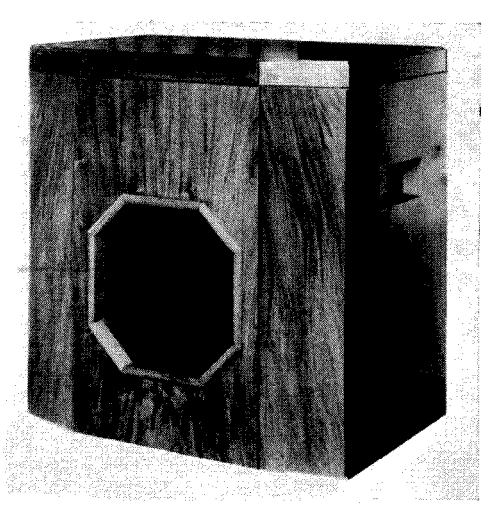
NEW ROLA LOUDSPEAKERS

THERE is no need for me to introduce "Rola." Rola loudspeakers have always played a large part in home-constructor sets during the last few years so that any radical departure from usual practice must be considered an event.

Rola has now introduced a range of dust-proof assembly models, as they call them. These new reproducers incorporate a new spider construction and filter assembly with the object of protecting the air gap, the vital part of a moving-coil loudspeaker, against the entrance of dust or other foreign material which does more harm than is generally known.

The new dustproof assembly is fitted, among others, to the standard range of permanent magnet and field-energised types selling at 35s. Cabinet models are also available.

You can get full details by filling in the coupon on this page and marking in the number at the end of this paragraph. **464**



One of the neatest and most efficient A.C. transportables on the market is the Pye model SP/AC. The controls are arranged radiogram fashion under the hinged lid

POLAR'S CONDENSERS

DURING the whole time that I have been interested in radio a white Polar bear has stood in a prominent place in my lab, though at the present time it is showing signs of wear caused through the dropping of mains transformers and suchlike on its stately figure !

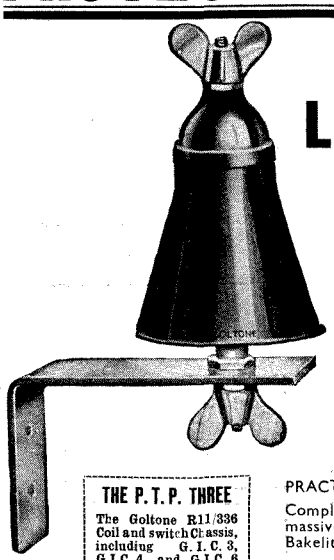
That old bear is to me a constant reminder of Polar condensers which, as you know, are just about as efficient as condensers can be.

Wingrove and Rogers, Ltd.—that is the firm's correct name—has sent along a copy of its latest in literature — a booklet of some twenty pages devoted entirely to variable condensers, except for a range of resistances, volume controls and fixed condensers.

Of particular interest is the wide range of full-vision drives—apparently a big Polar feature. It is surprising how many keen radio fans still use small apertures when such fine decorative scales can be easily substituted at really small cost.

I do suggest that you ask for a copy of this catalogue. It is of real interest to the wireless man. **465**

PROTECT YOUR SET



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The Goltone R11/336 Coil and switch Chassis, including G.I.C. 3, G.I.C. 4, and G.I.C. 6 Coils, complete with Q.M.B. Switch 36/6

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● **ROTHERMEL BRUSH DE LUXE PIEZO ELECTRIC PICK-UP**

This new Pick-up provides an average output of 1.8 volts with no pronounced peaks over the entire frequency range up to 10,000 c.p.s. The bronze-finished arm has a swivel head, and bearings are damped in order to eliminate resonances. The base has a ball race movement.

PRICE £4.4.0

ROTHERMEL-BRUSH R155 TWEETER

The Rothermel-Brush Piezo Electric "Tweeter" is a definite necessity in providing high-fidelity reproduction. It can be used with all moving-coil speakers and will provide a frequency response up to 12,000 cycles. Overall diameter 5 in. Depth, 1¾ in.

Price 21/-

CENTRALAB GRADED RADIOHM VOLUME CONTROLS

Centralab Volume Controls provide a resistance track 3⅝ in. long. For years they have been standardised by leading radio set manufacturers. The specification of "MY RADIOGRAM" includes one 10,000 ohm, one 25,000 ohm and one 250,000 ohm Centralab Volume Control, all without switch.

PRICE 3/9 each

Write to-day for "Piezo Electricity," a technical treatise on the application of Rochelle Salts to high-fidelity reproducers. Price 9d., post free.

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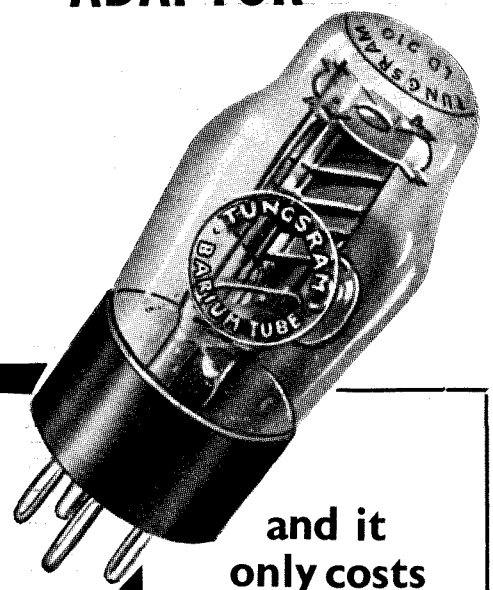

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World's Broadcast Wavelengths

Stations best received in the British Isles are indicated in bold type. This list is corrected up to the time of going to press

Note: Names in brackets are those of the main stations from which the greater part of the programmes are relayed

Wave-length	Name of Station	Dial Readings	Country
13.92	Pittsburgh W8XK		United States
13.97	**Daventry (Empire) GSH**		Great Britain
14.49	Buenos Aires LSY		Argentine
15.92	Bandoeng PLE		Java
16.36	Lawrenceville (N.J.) WLA		United States
16.38	**Rugby GAS**		Great Britain
16.5	Drummondville (CFA8)		Canada
16.56	Bandoeng PMC		Java
16.56	Buenos Aires LSY3		Argentine
16.81	Bandoeng PLF		Java
16.85	Kootwijk PCV		Holland
16.86	Daventry Empire GSG		Great Britain
16.878	**Boundbrook W3XAL (WJZ)**		United States
16.88	**Eindhoven PHI**		Holland
19.47	Riobamba PRADO		Ecuador
19.52	Szekesfeh.var		Hungary
19.56	**Schenectady W2XAD (WGY)**		United States
19.61	La Paz CP4		Bolivia
19.64	New York W2XE (WABC)		United States
19.66	**Daventry (Empire) GSI**		Great Britain
19.67	Coytesville N.J. WIXAL (WEEI)		United States
19.67	Tashkent (Rim)		U.S.S.R.
19.68	**Radio Coloniale FYA**		France
19.72	Saxonburg W8XK (KDKA)		United States
19.74	**Zeesen DJB**		Germany
19.82	Daventry (Empire) GSF		Great Britain
19.84	Rome (Vatican) HVJ		Italy
19.88	Moscow (RKI)		U.S.S.R.
19.93	W8XK, Saxonburg (KDKA)		United States
20.27	Rocky Point WQV		United States
20.31	Rocky Point N.Y. (WEB)		United States
21.43	Cairo SUV		Egypt
21.53	Rocky Point WIK		United States
21.58	Rocky Point WQP		United States
21.605	Rocky Point WQT		United States
21.83	Drummondvil'e CJA8		Canada
22.26	Rocky Point WAJ		United States
22.48	Santa Rita YVQ		Venezuela
22.684	**Zeesen (DHB)**		Germany
23.39	Radio Maroc (Rabat) CNR		Morocco
24.41	Rugby GBU		Great Britain
24.9	Kootwijk PDV		Holland
25	Moscow RNE		U.S.S.R.
25.25	Radio Colonial, Paris (FYA)		France
25.27	**Saxonburg (Pa.) W8XK (KDKA)**		United States
25.28	**Daventry (Empire) GSE**		Great Britain
25.34	Wayne W2XE (WABC)		United States
25.4	**Rome 2RO**		Italy
25.45	Boston WIXAL (WEEI)		United States
25.49	**Zeesen DJD**		Germany
25.532	**Daventry (Empire) GSD**		Great Britain
25.63	Radio Coloniale FYA		France
26.83	Funchal CT3AQ		Madeira
27.65	Nauen DFL		Germany
27.86	Rugby GBP		Great Britain
27.88	Marapicu PSG		Brazil
28.28	Rocky Point (N.J.) WEA		United States
28.5	Sydney VLK		N.S. Wales
28.98	Buenos Aires LSX		Argentine
29.03	Bermuda ZFD		West Indies
29.04	Ruysselede (ORK)		Belgium
29.35	Marapicu PSH		Brazil
29.59	Leopoldville OPM		Belgian Congo
29.64	Marapicu PSI		Brazil
29.84	Abu Zabel, Cairo SUV		Egypt
30	Radio Excelsior LR5		Argentine
30.1	Rome IRS		Italy
30.4	Lawrenceville WON		United States
30.4	Tokio JIAA		Japan
30.00	Madrid EAQ		Spain
30.77	Lawrenceville WOF		United States
30.9	**Rugby GCA**		Great Britain
31.23	Mexico City XETE		Mexico
31.25	**Lisbon CTIAA**		Portugal
31.26	Radio Nations HBL		Switzerland
31.28	**Philadelphia W3XAU (WCAU)**		United States
31.28	**Sydney VK2ME**		N.S. Wales
31.32	**Daventry (Empire) GSC**		Great Britain
31.35	**Millis W1XAZ (WBZ)**		United States
31.38	**Zeesen DJA**		Germany
31.41	Jelöy LCL		Norway
31.45	**Zeesen (DJN)**		Germany
31.48	**Schenectady W2XAF (WGY)**		United States
31.55	**Daventry (Empire) GSB**		Great Britain
31.55	Melbourne VK3ME		Victoria
31.55	Caracas YV3BC		Venezuela
31.58	Rio de Janeiro PSA		Brazil
31.6	**Skamlebaek**		Denmark
31.71	New Brunswick WKJ		United States
31.9	Bandoeng PLV		Java
32.71	**Lawrenceville WNA**		United States
32.79	Maracay YVQ		Venezuela
32.88	Szekesfehervar HA I'4		Hungary
33.26	Rugby GCS		Great Britain
33.59	Rocky Point (N.J.) WEC		United States
34.68	London VE9BY		Canada
36.65	Rio de Janeiro PSK (PRA3)		Brazil
37.04	Quito HCJB		Ecuador
37.33	Rabat (CNR)		Morocco
37.41	Suva VPD		Fiji Isles
38.07	Tokio JIAA		Japan
38.47	**Radio Nations HBP**		Switzerland
38.65	Kootwijk PDM		Holland
39.34	Tashkent RIM		U.S.S.R.
39.76	Moscow RKI		U.S.S.R.
39.82	Riobamba PRADO		Ecuador
40.3	Radio Nations HBQ		Switzerland
40.5	Bogota HJ3ABB		Colombia
40.54	Rocky Point WEN		U.S.A.
41.55	Bogota HKE		Colombia
41.6	Las Palmas EA8AB		Canary Isles
41.67	Singapore VSIAB		Sts. Settl'mts.
41.84	Grenada YN6RD		Nicaragua
41.9	Manizales HJ4ABB		Colombia
43	Madrid EA4AQ		Spain
43.86	Budapest HAT2		Hungary
44.61	Rocky Point WQO		United States
44.96	Maracay YVQ		Venezuela
45	Constantine FM8KR		Tunis
45	Guatemala City		S. America
45.02	Guayaquil HC2RL		Ecuador
45.38	Moscow RW72		U.S.S.R.
46.53	Barranquilla (HJIABB)		Colombia
46.69	Boundbrook W3XL (WJZ)		United States
46.7	Boston WIXAL		United States
47	Cali HJ5ABB		Colombia
47.5	S. Domingo HIZ		Dominican R.
47.8	Domingo HIAA		Dominican R.
48.75	Winnipeg CJRO		Canada
48.78	Caracas YV3BC		Venezuela
48.86	**Saxonburg (Pa.) W8XK (KDKA)**		United States
	Moscow (RKK)		U.S.S.R.
49.02	Bandoeng (YDA)		Dutch E.Indies
49.02	Wayne W2XE (WABC)		United States
49.08	**Caracas YVIBC**		Venezuela
49.1	**Daventry (Empire) GSL**		Great Britain
49.18	**Boundbrook W3XAL (WJZ)**		United States
	Chicago W9XF (WENR)		United States
49.22	Bowmanville VE9GW (CRCT)		Canada
49.26	St. John VE9BJ (CFBL)		N. Brunswick
49.3	La Paz CP5		Bolivia
49.34	Chicago W9XAA (WCFL)		United States
49.35	**Zeesen (D9M)**		Germany
49.39	Maracaibo V5BMO		Venezuela
49.4	Vienna OER2		Austria
49.43	Vancouver VE9CS (CKFC)		Brit. Columbia
49.47	Nairobi VQ7LO		Kenya Colony
49.5	**Skamlebaek**		Denmark
49.5	**Philadelphia W4XAU (WCAU)**		United States
49.5	Cincinnati W8XAL (WLW)		United States
49.586	**Daventry (Empire) GSA**		Great Britain
49.6	Bogota HJ3ABI		Colombia
49.67	Boston WIXAL (WEED)		United States
49.69	Priok (YDA)		Dutch E.Indies
49.83	**Zeesen DJC**		Germany
49.92	Havana COC		Cuba
49.96	**Drummondville VE9DN (CFCF)**		Canada
50	**Moscow RNE**		U.S.S.R.
50.8	Barcelona EA3AB		Spain

Continued on page 369

"W.M." Book Reviews

B.B.C. Annual, 1935 (British Broadcasting Corporation, 2s. 6d.).

THE B.B.C. yearly publication takes on a new form with the appearance of the 1935 issue; it is now called an annual and is somewhat differently arranged. It still remains excellent value for money, however, and contains a wealth of interesting matter.

The price is but half a crown, yet there are 192 pages nearly as large as those of "W.M.", and the production is quite well illustrated and attractively bound. To give a complete list of its contents would take too long, but here are some of the main items :—

A five-year review of broadcasting; this is treated in separate sections headed "Music," "Public Speeches and Ceremonies," "Commentaries on Sport," "Talks," "School Broadcasts," "Religion," "Plays," "Variety," "Miscellaneous Events," "Children's Hour," "Outstanding Relays."

Christmas Messages, by H.M. The King.

◇ ◇ ◇

The Electrical Encyclopedia. (The Waverley Book Co., four volumes, 1,480 pages, £3 10s.).

WE have had the first volume of this work submitted to us for review, and while we must confess that time has not permitted us to do our full duty by it, we have dipped sufficiently deep into it to have discovered that it is a vertiable mine of information. We found one or two slight loosenesses in the radio portions, but our general impression is that of a very sound piece of work.

The names and qualifications of the Associate Editors are an indication of the pains which have been taken to ensure accuracy :—

Arthur Arnold, A.M.I.E.E., A.M.I.Mech.E.

R. A. Baynton, B.Sc.(Eng.), A.C.G.I.

Philip Kemp, M.Sc.(Tech.), M.I.E.E., A.M.I.Mech.E.

S. O. Pearson, B.Sc., A.M.I.E.E.

S. Austin Stigant, M.I.E.E., F.Am.I.E.E.

G. W. Stubbings, B.Sc.(Lond.), F.Inst.P., A.M.I.E.E.

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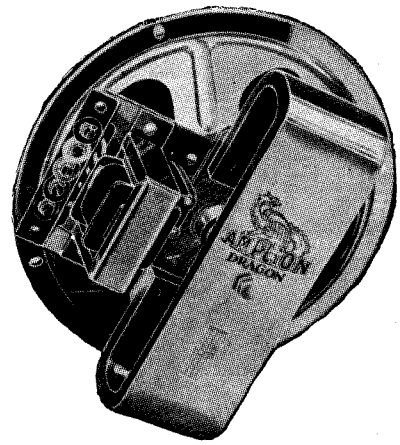

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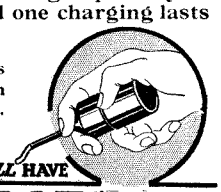

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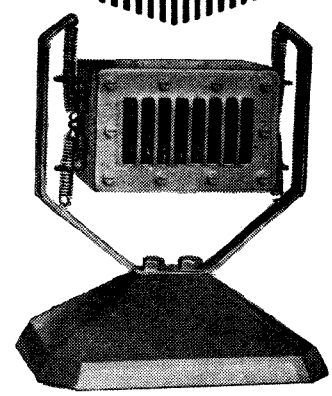

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WORLD'S BROADCAST WAVELENGTHS

Continued from page 394

Note Specially the Re-arrangement of British Wavelengths

Wave-length	Name of Station	Dial Readings	Country
50.26	**Rome (Vatican) HVJ**		Italy
50.42	Domingo HIX		Dominican R.
50.6	Medellin HJ4ABE		Colombia
55.56	**Szehesfehevar**		Hungary
56.9	Königswusterhausen (DTG)		Germany
57.03	**Rocky Point WQN**		United States
58.0	Bandoeng PMY		Java
58.31	**Prague**		Czechoslovakia
60.3	Rugby GBC		Great Britain
62.5	**Long Island (N.J.) W2X**		United States
62.56	London		Ontario
65.93	Rocky Point WAD		United States
67.11	Soerabaja (YDA)		Dutch E. Indies
68.18	Moscow (RFCK)		U.S.S.R.
69.44	Rugby GDB		Great Britain
70.2	Khabarovsk RV15		U.S.S.R.
73	Quito (HCJB)		Ecuador
76	Maracay (YV11AM)		Venezuela
80	Lisbon CTICT		Portugal
84.5	Berlin D4AGE		Germany
85.9	Boston WIXAL		United States
98.68	Priok (YDB)		Dutch E. Indies
203.5	Plymouth		Great Britain
	Bournemouth		Great Britain
204.8	Pecs		Hungary
206	Eiffel Tower		France
208.6	Miskolcz		Hungary
209.9	Beziers		France
	Alexandria		Egypt
211.3	Tampere		Finland
215.4	Radio Lyons		France
216.8	Warsaw No. 2		Poland
218.2	Basle, Berne		Switzerland
221.1	**Turin (2)**		Italy
222.5	**Milan (2)**		Italy
222.6	**Dublin**		Irish F. State
	Bordeaux S.O.		France
	Königsberg		Germany
224	Montpellier		France
	Lodz		Poland
225.6	Hanover		Germany
	Bremen		Germany
	Flensburg		Germany
	Stettin		Germany
	Magdeburg		Germany
230.2	Danzig		Germany
231.8	Linz		Austria
	Dornbirn		Austria
233.5	**Aberdeen**		Great Britain
	Dresden		Germany
235.1	Stavanger		Norway
236.8	**Nurnberg**		Germany
238.5	San Sebastian		Spain
	Rome (3)		Italy
240.2	Juan-les-Pins		France
242	**Cork**		Irish F. State
243.7	**Gleiwitz**		Germany
245.5	**Trieste**		Italy
247.5	**Lille PTT**		France
249.2	Prague Strasnice (2)		Czechoslovakia
51	Frankfurt-am-Main		Germany
	Trier		Germany
	Freiburg-im-Breisgau		Germany
	Cassel		Germany
	Kaiserslautern		Germany
253.2	Kharkov (2)		U.S.S.R.
255.1	**Copenhagen**		Denmark
257.1	**Monte Ceneri**		Switzerland
259.1	Kosice		Czechoslovakia
261.1	**London National**		Great Britain
	North National		Great Britain
	West National		Great Britain
263.2	**Turin (1)**		Italy
265.3	Horby		Sweden
267.4	**Newcastle**		Great Britain
	Nyiregyhaza		Hungary
269.5	Fecamp		France
270	**Moravska-Ostrava**		Czechoslovakia
271.7	Madona		Latvia
274	Madrid EAJ7		Spain
276.2	Falun		Sweden
	Zagreb		Yugoslavia
278.6	Bordeaux PTT		France
280.9	Tiraspol		U.S.S.R.
283.3	**Bari**		Italy
285.7	**Scottish National**		Great Britain
288.5	Leningrad (2)		U.S.S.R.
	Rennes PTT		France
291	**Königsberg**		Germany
	Parede		Portugal
293.5	Barcelona (EAJ15)		Spain
296.2	**Midland Regional**		Great Britain
298.8	**Bratislava**		Czechoslovakia
301.5	Hilversum		Holland
304.3	**Genoa**		Italy
307.1	**Belfast**		N. Ireland
309.9	Odessa		U.S.S.R.
312.8	**Poste Parisien, Paris**		France
315.8	**Breslau**		Germany
318.8	Goteborg		Sweden
	Algiers		North Africa
321.9	**Brussels (2)**		Belgium
325.4	Brno		Czechoslovakia
328.6	Radio Toulouse		France
331.9	**Hamburg**		Germany
335.2	Helsinki		Finland
338.6	Graz		Austria
342.1	**London Regional**		Great Britain
345.6	Poznan		Poland
349.2	**Strasbourg**		France
352.9	Bergen		Norway
	Valencia		Spain
356.7	**Berlin**		Germany
360.6	Moscow (4)		U.S.S.R.
364.5	**Bucharest**		Roumania
368.6	**Milan**		Italy
373.1	**West Regional**		Great Britain
	Salonika		Greece
377.4	**Lvov**		Poland
	Barcelona (EAJ1)		Spain
382.2	**Leipzig**		Germany
386.6	**Toulouse PTT**		France
391.1	**Scottish Regional**		Great Britain
395.8	**Katowice**		Poland
400.5	Marseilles PTT		France
405.4	**Munich**		Germany
410.4	Seville		Spain
	Tallinn		Estonia
	Madrid (Espana)		Spain
415.5	Kiev		U.S.S.R.
420.8	**Rome**		Italy
426.1	**Stockholm**		Sweden
431.7	**Paris PTT**		France
437.3	**Belgrade**		Yugoslavia
443.1	**Sottens**		Switzerland
449.1	**North Regional**		Great Britain
455.9	**Cologne**		Germany
463	**Lyons PTT**		France
470.2	**Prague (1)**		Czechoslovakia
476.9	Trondheim		Norway
483.9	**Brussels (1)**		Belgium
492	**Florence**		Italy
499.2	**Sundsvall**		Sweden
	Rabat		Morocco
506.8	**Vienna**		Austria
514.6	Agen		France
	Riga		Latvia
522.6	**Stuttgart**		Germany
531	**Athlone**		Irish F. State
539.6	**Beromünster**		Switzerland
549.5	**Budapest**		Hungary
559.7	Wilno		Poland
	Bolzano		Italy
569.3	Viipuri		Finland
	Ljubljana		Yugoslavia
578	Innsbruck		Austria
	Hamar		Norway
696	Oulu		Finland
748	Moscow		U.S.S.R.
	Geneva		Switzerland
765	Boden		Sweden
834	Budapest No. 2		Hungary
845	Finnmark		Norway
1,107	Moscow (2)		U.S.S.R.
1,186	Tromso		Norway
1,224	Leningrad		U.S.S.R.
1,261	**Kalundborg**		Denmark
1,304	**Luxembourg**		Luxembourg
	Ankara		Turkey
1,339	Warsaw		Poland
1,389	**Motala**		Sweden
1,395	**Eiffel Tower**		France
1,442	Minsk		U.S.S.R.
1,500	**Droitwich National**		Great Britain
1,571	**Deutschlandsender**		Germany
1,600	Istanbul		Turkey
1,648	**Radio Paris**		France
1,724	**Moscow No. 1**		U.S.S.R.
1,807	Lahti		Finland
	Kootwijk		Holland
1,875	Huizen		Holland
	Brasov		Roumania
	Kaunas		Lithuania
1,935			

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See page 328 for details of a novel and interesting competition run in conjunction with this receiver.

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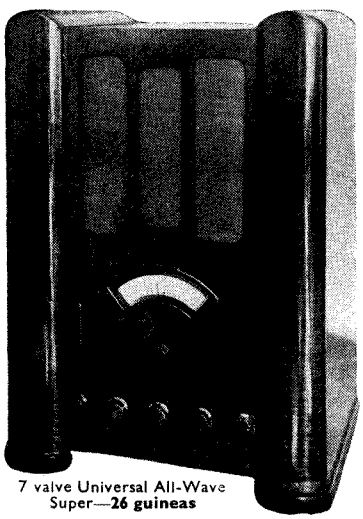

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Write for particulars to EUGEN J. FORBAT, Sole Agents for Great Britain, 28/29 SOUTHAMPTON STREET, STRAND, LONDON, W.C.2.

The R.M.A. *Resistance Colour Code*

IT would appear from correspondence that quite a number of readers find the approved colour-code system of resistance marking difficult to understand; probably the explanations which follow will make the actual meaning of the system quite plain, but only practice will enable one to memorise it.

Figure Code

Black	0	Brown ..	1
Red	2	Orange ..	3
Yellow	4	Green ...	5
Blue	6	Violet....	7
Grey	8	White ...	9

Method of Coding

The first figure of the resistance value is given by the colour of the body. The second figure is given by the colour of the end, while the number of ciphers to follow these figures is indicated by the colour of the dot on the body.

Example : Red body, Green end, Brown dot. The first figure is evidently 2, the second is 5, and there are no ciphers, since Black means " none " in this case.

Example : Red body, Green end, Brown dot. First and second figures as before, followed by one cipher, that is, the rating is 250 ohms.

Example : Red body, Green end, Red dot, means 2,500 ohms.

Example : Red body, Blue end, Orange dot, 26,000 ohms.

Example : Red body, Black end, Orange dot, 20,000 ohms.

INTERESTING NEW DOUBLE-DIODE

A NEW double - diode valve recently announced by Osram (G.E.C.) is remarkable for the fact that it can be used in either A.C. or series-connected " Universal " circuits. This is rendered possible by the heater rating: 0.3 ampere at 4 volts.

The valve is small in size and carries five pins, both anodes being connected to pins. Either clear or metallised it costs 5s. 6d. The type reference is D41.

When writing to Advertisers please mention WIRELESS MAGAZINE

PETO-SCOTT

SEND US YOUR ENQUIRIES FOR EVERYTHING RADIO
IMMEDIATE DELIVERY CASH C.O.D.

PILOT AUTHOR KITS

Build with a Pilot Author Kit and make a 100 per cent success certain. Since 1919 the most popular Kits with Home Constructors the whole world over because they are exact to the designer's specification and are complete down to the last screw.

P.T.P. THREE

Described in this Issue

KIT "A" Author's Kit of first specified parts, including Ready-drilled Metaplex Chassis and 2 Ebonite Terminal Strips, less Valves, Cabinet, and Speaker. Cash or C.O.D. **£6 :14 :6** Carriage Paid.
Or 12 monthly payments of 12/3.

KIT "B" As for Kit "A" but including set of 3 specified valves, less cabinet and speaker. Cash or C.O.D. Carriage Paid, £8/7/0, or 12 monthly payments of 15/3.

KIT "C" As for Kit "A" but including valves and Peto-Scott consolette cabinet, less speaker. Cash or C.O D. Carriage Paid, £9/6/6, or 12 m'thly payments of 17/-.

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1 **Peto-Scott** P.T.P.3 Consolette Cabinet	19	6
1 **Peto-Scott** Ready-drilled Metaplex Chassis, complete with 2 Ebonite Terminal Strips as specified	6	6
1 **Goltone** 3-coil Switch Chassis	1 16	6
2 **J.B.** Nu-gang Condensers (Single-stage and Double-stage) with disc drives	1 8	0
3 **Specified Valves**	1 12	6
1 **Amplion** "Dragon" Speaker	1 9	6

"W.M." NEW STYLE S. W. ADAPTOR

Described in this Issue

KIT "A" Author's Kit of first specified parts, including Peto-Scott Metaplex Baseboard and Ready-drilled Metaplex Panel, but less valve. Cash or C.O.D. **£2:9:6** Carriage Paid
Or 11 monthly payments of 5/-.

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	£	s.	d.
1 **Peto-Scott** Metaplex Baseboard and Ready-drilled Metaplex Panel as specified		3	3
1 Set of 4 **Eddystone** Coils (12-170 metres)		16	6
2 **Polar** Type "C" Short Wave Condensers		16	9
1 **Tungsram** Valve (Type L.D.210)		3	9

1935 A.C. STENODE

KIT "A" Cash or C.O.D. Carr. Paid. *Or 12 m'thly payments of* 26/9 **£14 12 6**
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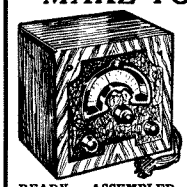
KIT "C" Cash or C.O D. Carriage Paid, £8/10/0, or 12 monthly payments of 15/6.

MAKE YOUR SET AN



ALL WAVE SET !
***B.T.S.* 1935**
Shortwave ADAPTOR

READY ASSEMBLED Cash or C.O.D. Carriage Paid. With 2 plug-in coils, 13-26 and 24-52 metres. Extra coils, 46-96 and 90-190 metres 4/6 each. YOURS FOR **52/6** **7/6** and 10 monthly payments of 5/-

Simply plugs into your present battery or A.C. mains set and gives world-wide reception. The only adaptor at the price incorporating **100-1 ratio aerial tuning and slow-motion reaction ;** for use either as Plug-in or Superhet Short-wave Adaptor; Air Dielectric Reaction and Tuning Condensers; Walnut Grained Bakelite Panel; Walnut Polished Cabinet. **Send for Fully Descriptive Leaflet.**

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77 (W.M.6) **CITY ROAD, LONDON, E.C.1**
Telephone : Clerkenwell 9406/7
West End Showrooms: 62 High Holborn, London, W.C.1
EST. 1919

Tests of New Apparatus

TUNGSRAM D418 DIODE VALVE

Description

A SINGLE diode valve with a 4-volt heater is now included in the Tungsram range.

The valve, which is known as the D418, is mounted in a very small tubular bulb with a thimble connector for the actual diode. There are three pins for the heater and cathode. Sprayed metallisation is used on the bulb.

Observations

The appearance is good and the construction seems to be very satisfactory, the whole assembly being rigid and it does not appear that any mechanical trouble is likely to arise.

A curve was taken of the sample submitted, and this shows that it has a long straight portion, and as a result the valve is suitable for handling any ordinary input voltage without distortion. We regard it as an entirely satisfactory production.

Measurements

Nominal heater current: 18 ampere.

Actual heater current: .18 ampere.

The valve is made by the Tungsram Electric Lamp Works (Great Britain), Ltd., of 72 Oxford Street, London, W.1, and costs 4s.

The new Tungsram D418 diode valve is particularly small, being only about 2 in. high

B.T.S. SHORT-WAVE ADAPTOR

Description

THE short-wave adaptor marketed by British Television Supplies, Ltd., can be described as a versatile component. It is very flexible because it is suitable for battery and mains operation, and it can be arranged to work either as a detector unit or on the superheterodyne principle.

The unit comprises an assembly of two alternative plug-in coils, together with a reaction condenser and a tuning condenser. The latter is driven through a slow-motion control associated with a disc drive. The aerial connection is taken through a variable condenser to the short-wave coil.

A system of high-frequency chokes and condensers is used so that the output is suitable for appropriate connection to a receiver or subsequent amplifier.

There is also an incorporated adaptor plug which can be fitted into an existing receiver.

Observations

The unit is soundly constructed and the controls work smoothly. The instructions issued with the unit are explicit and no difficulty should be experienced in connecting it to any type of set. The coil holder is accessible, and the same can be said of the valve.

Results on Test

Tests showed that the design of the circuit is such that considerable adjustment to the reaction condenser is necessary when tuning over either waveband. The variable series-aerial condenser was found to be an advantage in eliminating the effect of blind spots with certain aerial constants.

Hand-capacity effects were found to be, for all practical purposes, completely absent, and no difficulty was experienced in tuning-in and successfully holding any station.

Conversion Efficiency

The conversion efficiency of the unit depends, of course, entirely upon the valve used and the general operating conditions. The unit was tested with certain representative receivers and satisfactory results were obtained. The output depended to some extent upon the correct setting of the reaction adjustment when used for superheterodyne work.

As an ordinary detector unit the device functioned quite well and the performance given is quite representative of standard short-wave practice.

The Adaptor costs £2 12s. 6d. and is made by British Television Supplies, Ltd., W.1, Bush House, London, W.C.2.

The QUINTESSENCE of QUALITY

DO NOT ATTEMPT TO JUDGE QUALITY BY PRICE ALONE

If the price is right, that is one essential. But your real interest is quality. Make sure of this by buying 362 Valves. Entirely British. Non-microphonic. No mains hum. BATTERY PRICES.—H.HL and L., 3/6; Power, 4/-; Super Power, 4/6; SG and VS, 7/6; VP2 9/-; Pentode type, 10/-; BA and BX, 9/-. MAINS PRICES.—ACHL4, 7/6; P625, 8/-; ACPX4, 9/-; ACSG4 and ACVS4, 12/6; ACME and ACHM, 13/-; RB41, 7/6; RB42, 10/-.
If your dealer is not an appointed 362 agent, do not be persuaded to buy the next best.
Post free direct from makers, cash with order.
The 362 Radio Valve Co., Ltd., Dept. M, Stoneham Road, London, E.5. *'Phone*: Clissold 1294.

H.L.2 3/6

The only valve with a 6 months' guarantee

"P.T.P. THREE"

SPECIFIED AGAIN

Nugang Condenser, Single Stage (Type A) with disc drive. Cat. No. 2081 10/6

Nugang Condenser, 2-Stage (Type A) with disc drive. Cat. No. 2063 17/6

For further particulars write to :

JACKSON BROS. (LONDON), LTD., 72, Thomas Street, S.E.1. Tel.: Hop. 1837

Scanning in Practice

Continued from page 355

second. Thus in the thirty-line transmission the drum requires to make twelve and a half turns per second, since that is the picture frequency of this particular service. We thus have a drum fitted with thirty mirrors running at 375 revolutions per minute.

At the Receiving End

This example will serve as a general illustration of mechanical metohds of scanning in transmission. Now let us turn to the receiving question. Here a very similar system can be used; there is again a drum carrying mirrors set exactly as before and upon them is focused a pencil of light from a local source. The resulting moving light spot is arranged to fall upon a screen of some sort (usually ground glass) and will trace out thereon the usual system of parallel lines all closely adjacent to each other.

Light Modulation

If now we can manage to vary the intensity of the light spot at each instant to correspond with the brightness of the light falling upon the photo-electric cells at the transmitting studio we shall quite evidently build up on the receiving screen the same details of light and shade. So long as this can be done in exact correspondence as to position, the result will be a reproduction on the receiving screen of the original scene and this is ensured by causing the receiving drum to run in synchronism with that of the transmitter.

The spot of light which scans the receiving screen is made to vary in brightness in the appropriate manner by "modulating" it in accordance with the incoming television signal. For this purpose the device known as a Kerr Cell is often employed; it may be regarded as a sort of control tap for light, allowing such an amount of illumination to pass through to the screen as is permitted by the strength of the voltages applied to the cell.

There are many other methods of scanning and image-building on mechanical principles, but since all are tending to go out of use in these days I have chosen just one to illustrate the system. I do not propose to describe all the various disc methods and neon lamp systems, because I believe that they will soon be of purely historical interest.

It has been my endeavour to explain just the fundamental principles of the process of scanning so that the reader may feel sufficiently familiar with the basic ideas to understand without difficulty, explanations of the more advanced electrical scanning systems.

For an explanation of the electron camera used in the Baird system, I would refer him to page 90 of the March, 1935, number of "W. M.", while for a description of the Iconoscope—a device which fulfils an equivalent function in the E.M.I. system—he should turn to page 180 of the April issue.

Both these devices are used in transmission; the corresponding method at the receiving end makes use of the cathode-ray tube, but this represents too large a subject for us to tackle this month.

VALVE for "ULTRA-SHORTS"

WE learn that a certain leading valve manufacturer is about to release a new type of great interest —a "triode-hexode" possessing special advantages as a frequency-changer for ultra-short waves. We hope to be in a position to publish full technical details next month.

HEAR America, hear Short Wave stations in every corner of the World. Plug the *B.T.S.* Short Wave Adaptor into your present Battery or A.C. Mains Set and instantly convert it to an efficient all-wave receiver . . . with no alterations to your set whatsoever. No other adaptor at the price incorporates *all* the *B.T.S.* features. Send to-day for fully descriptive leaflet.

52/6 With 2 Plug-in Coils, 13-26 and 24-52 metres. Extra coils, 46-96 and 90-190 metres, 4/6 each.

FROM ALL DEALERS.
If any difficulty, send direct.

B.T.S. Short Wave COILS

SPECIFIED for the
"W.M." NEW STYLE S.W. ADAPTOR

No. 1. 13-26 *metres* 4/-
No. 2. 24-52 *metres* 4/-
No. 3. 46-96 *metres* 4/6
No. 4. 90-190 *metres* 4/6

SET of 4 **16/-**

FROM ALL DEALERS
or send direct

Short Wave and Television Specialists

B.T.S.

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BUSH HOUSE, Dept. "W.M.", LONDON, W.C.2

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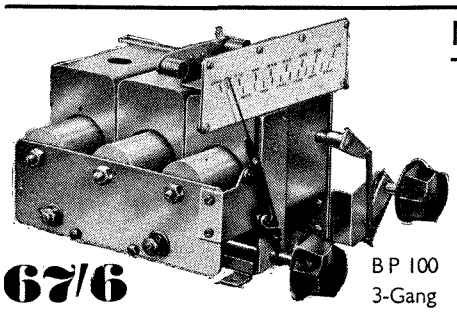


67/6 BP 100 3-Gang

MR. PERCY W. HARRIS PAYS TRIBUTE TO VARLEY PERMEABILITY TUNING

For his 1935 Radiogram Mr. Percy W. Harris has chosen the Varley Permeability Tuner, illustrated here. Another tribute to the perfect tuning unit. Varley have an ample stock of these tuners at their works, and they guarantee prompt delivery. Get full details from Varley *now*.

Varley

Oliver Pell Control, Ltd., Bloomfield Road, Woolwich, S.E.18. *Telephone: Woolwich 234*

BLUEPRINT COUPON

Valid only until June 29, 1935 (or until July 31, 1935, for overseas readers)

FOR ONE BLUEPRINT ONLY

If you want a full-size blueprint of the set constructionally described in this issue for half price, cut out the above coupon and send it, together with a postal order, to Blueprint Department, WIRELESS MAGAZINE, 8-11 Southampton Street, Strand, London, W.C.2.

This coupon is valid for one blueprint only at the price indicated:—
ENTHUSIAST'S POWER AMPLIFIER (page 369), No. WM 387, price 9d., post paid.
NEW STYLE SHORT-WAVE ADAPTOR (page 336), No. WM 388, price 6d., post paid.
THE P.T.P. THREE (page 329), No. WM 389, price 6d., post paid.

INFORMATION COUPON

Valid only until June 29, 1935 (or until July 31, 1935, for overseas readers)

If you want to ask any questions, cut out the above coupon and send it, together with a postal order for 1s. and stamped, addressed envelope, to the Information Bureau, WIRELESS MAGAZINE, 8-11 Southampton Street, Strand, London, W.C.2.

Note that not more than two questions may be asked at a time and that queries should be written on one side of the paper only.

Under no circumstances can questions be answered personally or by telephone. All inquiries must be made by letter so that every reader gets exactly the same treatment.

Alterations to blueprints or special designs cannot be undertaken: nor can readers' sets or components be tested.

If you want advice on buying a set, a stamped, addressed envelope only (without coupon or fee) should be sent to the Set Selection Bureau, WIRELESS MAGAZINE, 8-11 Southampton Street, Strand, London, W.C.2

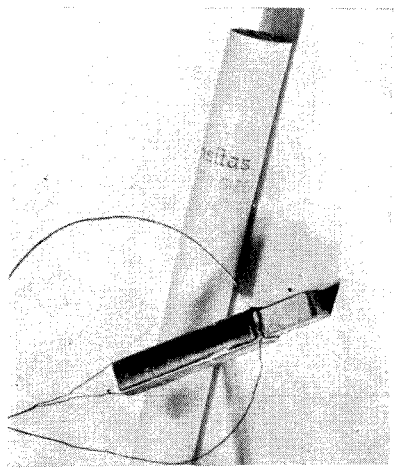
NEW IDEA IN TUNING UNITS

Continued from page 343

to work on the principle of eight tightly-coupled rather flatly-tuned circuits giving a reasonable overall selectivity.

Linked Circuit

The central pair of circuits on the medium band being joined together in the way shown gives a kind of linked circuit very similar to that used in the early days of radio telegraphy in the Marconi Multiple tuner. As Mr. Brown explained that the direction of winding of successive coils appeared to have a considerable influence on



One of the small coils with its iron core used in the new Brown tuner photographed with a standard-size cigarette. The little core is shown partially withdrawn from the coil

the functioning of the set, they probably provide a combination of positive and negative couplings in producing the overall effect.

Tight Conductive Coupling

The joining up of the centre points of the coils must necessarily give a very tight conductive coupling here, and the placing of unscreened coils side by side must also give an inductive coupling. If now the inductive coupling is out of phase with this conductive coupling the overall tightness of coupling may be less than would at first appear.

The device is being handled by National Radio Service, Ltd.

Name This Receiver!

COMPETITION COUPON

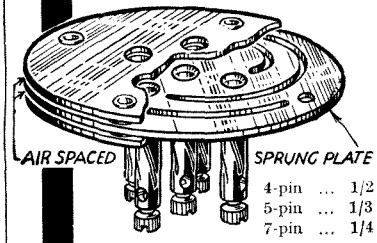
This coupon must accompany all entries for the competition detailed on page 328
W.M., June, 1935

CLIX

4 - PIN
5 - PIN
7 - PIN

"AIRSPRUNG" VALVEHOLDERS

Specified for the "P.T.P. THREE"



4-pin ... 1/2
5-pin ... 1/3
7-pin ... 1/4

CLIX: The only Antimicrophonic Chassis Mounting Valveholder, supplied with or without terminals. Also specified for the "1935 A.C. STENODE." See May issue.

LECTRO LINX LTD.
79a, Rochester Row, London, S.W.1

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"Wireless Magazine" Blueprint Service

These blueprints are full-size. Copies of appropriate issues of "Practical Wireless," "Amateur Wireless," and of "Wireless Magazine" containing descriptions of most of these sets can be obtained at 4d. and 1s. 3d. each, respectively, post paid. Index letters "P.W." refer to "Practical Wireless" sets, "A.W." refer to "Amateur Wireless" sets, and "W.M." to "Wireless Magazine" sets. Send, preferably, a postal order (STAMPS OVER SIXPENCE UNACCEPTABLE) to "Wireless Magazine" Blueprint Dept., Geo. Newnes, Ltd., 8-11 Southampton Street, Strand, W.C.2.

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Mains Operated

Two-valvers: Blueprints, 1s. each.

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Consolectric Two (D, Pen) A.C.	*23.9.33*	AW403

★ SPECIAL HALF-PRICE OFFER

Blueprints of the following "Wireless Magazine" sets described in this issue are obtainable at the special price, given below, if the coupon on facing page is used before June 29.

Enthusiast's Power Amplifier (4-v., A.C.) WM387		9d.
New Style Short-wave Adaptor WM388		6d.
P.T.P. Three (SG, D, Pen)	WM389	6d.

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Mantovani A.C. Three (HF Pen, D, Pen) A.C.	*Nov. '34*	WM374
Home-lovers' New All-electric Three (SG, D, Trans) A.C. ...	*25.3.33*	AW383
S.G. Three (SG, D, Pen) A.C....	*3.6.33*	AW390
A.C. Triodyne (SG, D, Pen) A.C.	*19.8.33*	AW399
A.C. Pentaquester (HF Pen, D, Pen) A.C.	*26.6.34*	AW439

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All Metal Four (2 SG, D, Pen) A.C.	*July '33*	WM329
AC/DC Straight A.V.C. 4 (2 HF, D, Pen) A.C./D.C. ...	*8.9.34*	AW446
"W.M." A.C./D.C. Super Four	*Feb. '35*	WM382
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SUPER-HETS

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Merrymaker Super, A.C. ...	*Dec. '33*	WM345
Heptode Super Three, A.C. ...	*May '34*	WM359
"W.M." Radiogram Super, A.C.	*July '34*	WM366
"W.M." Stenode, A.C. ...	*Sep. '34*	WM370
1935 A.C. Stenode (A.C. Superhet)	*Apl. '35*	WM385
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